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## MINERALOGY.

### THE IOLA (KANSAS) MINERAL WELL.

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At the request of the proprietors, I visited this interesting phenomenon during the month of June 1876, for the purpose of collecting a supply of water for a thorough analysis. The so-called "well" is, as is well known, simply an old boring by coal prospectors. Its total depth is 736 feet. When at the depth of 626 feet the diamond drill with which the boring was made, suddenly dropped some twenty inches through an apparently vacant seam. A violent upward rush of water and gas immediately began through the tube, and with more or less irregularity has since continued without cessation. The boring is tubed to the depth of 149 feet only. The water

is expelled by the elastic force of the gas in very irregular pulsations, at varying intervals escaping alternately first with great impetus and then with a succession of fainter impulses. The sections of the core obtained during the boring present, when arranged in order, a most interesting view of the geological section of this region; especially instructive as it occurs over the Lower Coal Measure area of this State. The water of the well is, of course, largely charged with mineral matters, a portion of which being held in solution by the free carbonic acid with which the water abounds, is deposited as a thick sediment upon allowing the water to stand for some time freely exposed to the open air. By repeated and careful experiments, I determined the temperature of the water to be uniformly 61° F., as from the great depth from which the water rises it exhibits little or no variation in temperature through summer or winter. A full analysis of the water presents the following results: Specific Gravity, 1.0138. Temperature, 61° F. Total Mineral Matter to the Imperial Gallon, 1100.081 grains. Carbonic Acid Gas, 145.891 cub. in.

| | |
|---|---|
| Sodium Chloride | 971.506 grains. |
| Potassium " | 17.909 " |
| Magnesium " | 7.305 " |
| Sodium Bi-Carbonate | 8.158 " |
| Calcium " | 60.687 " |
| Magnesium " | 25.485 " |
| Iron " | 3.929 " |
| Silica | .602 " |
| Sodium Iodide | Distinct Traces. |
| Sodium Bromide | Abundant Traces. |
| Organic Matter | 2.000 " |
| Suspended Matter | 2.500 " |
| Total | 1100.081 " |

The results of the above analysis have been in all cases duplicated, and in many cases triplicated. Like the product of all mineral wells, this water of course varies somewhat, within slight limits, in its composition. Thus in the water examined by me there was absolutely no trace whatever of sulphates, whereas I observe that Prof. G. E. Patrick in his paper read before the Academy last year, reports the presence of a very small quantity of Sodium Sulphate. I notice, however, that Mr. Patrick also reports in his analysis an appreciable quantity of Ferric Chloride (Sesqui-Chloride of Iron). If this salt of iron is indeed present in this water it is a most remarkable fact, as there is no well authenticated analysis showing its existence in any mineral spring in the United States. My own analysis indicates no such condition, the iron being present in the water analysed by me in its usual form in all mineral waters, viz. held in solution as the Bi-carbonate. For the purpose of comparison I give below a tabular view showing the composition of the Iola water as contrasted with that of two of the

most noted of the Saratoga Springs, the "Congress" and the "United States:"

IN GRAINS TO THE IMPERIAL GALLON.

| | Iola. | Congress | United States. |
|---|---|---|---|
| Bi-carbonate of Sodium | 8.158 | 7.472 | 3.240 |
| " " Calcium | 60.687 | 99.592 | 64.672 |
| " " Magnesium | 25.485 | 72.152 | 43.192 |
| " " Iron | 3.929 | .248 | .520 |
| " " Lithium | | 2.992 | 3.040 |
| " " Barium | | .760 | .752 |
| Chloride of Sodium | 971.506 | 400.440 | 141.872 |
| " " Potassium | 17.909 | 8.048 | 8.604 |
| " " Magnesium | 7.305 | | |
| Sulphate of Potassium | | .888 | |
| Phosphate of Sodium | | .016 | .016 |
| Iodide of Sodium | Traces | .136 | .048 |
| Bromide of Sodium | Traces | 8.552 | .848 |
| Alumina | | Traces | .096 |
| Silica | .602 | .840 | 3.184 |
| Organic Matter | 2.000 | Traces | Traces |
| Carbonic Acid Gas (cub. in.) | 145.891 | 432 | 240 |

The Iodide and Bromide of Sodium, though in minute amount, are present in very appreciable quantities in the water of the Iola well, and to their influence is undoubtedly due much of the asserted beneficial effects of this water upon scrofulous and other allied difficulties. The Carbonic Acid present in the Iola water is considerably less than that afforded in the waters of the Saratoga springs, though an abundance is present to remove, by its sparkling influence, much of the disagreeable flavor of the water, which otherwise, from the large amount of mineral matter present, might prove somewhat unpleasant.

The gas, which is thrown from the well with such force and in such quantity, is almost wholly made up of Light Carburetted Hydrogen, commonly known as "Marsh Gas." From its very slight solubility (1 part in 27 by volume, Storer), it of course exists in very small quantities only in the water itself, though it is constantly bubbling up through it. Notwithstanding the views of many observers and writers, the escape of this gas in such abundance from this well is neither anomalous or startlingly unusual. It is no uncommon occurrence in many portions of the country in sinking similar borings for coal, salt or oil, to find this gas suddenly escaping with force sufficient to stop or reverse the engine. This Light Carburetted Hydrogen is produced in immense quantities in nature from the slow decomposition of all deposits of vegetable matter, and frequently escapes naturally in great abundance. The large supply of this gas near Fredonia, N. Y., by which the entire village is lighted, is too well known to need comment here. Near Oberlin, Ohio, is a spring from which I have frequently discovered the gas escaping in great quantity, forming, when lighted, a flame of large

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size. Near Kanawha, Va., and at many other places too numerous to mention, this same gas has been known to escape for years without cessation. It is this gas which constitutes the dreaded "fire damp" of our coal mines, the cause of all the terrible disasters and explosions with which the history of coal mining is filled. Points from which it escapes in much the same manner as at Iola, without the efflux of water, are known to the miners as "blowers," and are liable to suddenly appear at any time upon opening a new seam.

Nor, upon the other hand, is it at all necessary, in endeavoring to explain the origin of such large quantities of this gas as escape from the Iola boring, to resort to the popular but very improbable hypothesis of the decomposition of the coal itself by the agency of heat; especially inapplicable to this uniformly undisturbed portion of the Lower Coal Measure of Kansas. There is no evidence to show that this vacant seam of 20 inches encountered at this great depth was originally occupied by a coal bed at all, and such a supposition is not in any way essential. There can be no doubt but that this opening, whether produced by flexure of lower strata or otherwise, communicates laterally with a very large tract of coal bearing formations, possibly with a good portion of the Western Interior Coal Area. And when we remember the fact that this Light Carburetted Hydrogen is given off in large quantities from many varieties of bituminous coal at *ordinary temperatures*, we need be at no loss to account for its appearance at this opening in such considerable amount. It is from this cause that the gas accumulates in coal mines in such dangerous quantities; and it is by no means impossible that this Iola boring may serve as the "vent hole" for a considerable area of coal bearing territory. This escape of Light Carburetted Hydrogen from soft bituminous coal at ordinary temperatures is of course a continuation of the original coal forming process: a slow decomposition of vegetable matter under a very limited supply of atmospheric oxygen, in which the gaseous products are principally Light Carburetted Hydrogen with Carbonic Acid (di-oxide), small portions of Carbonic Oxide and occasionally still smaller quantities of free Hydrogen. The appearance of the Light Carburetted Hydrogen in so liberal quantities at the Iola well, as also the composition of the water brought up by the pulsations of the gas itself, are both matters of very great scientific interest; but neither their interest nor their importance are in any way augmented by ascribing miraculous properties to the one or an anomalous origin to the other.

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## PRECIOUS STONES.

The same love of brilliancy which in childhood is manifested by a desire to grasp the flame of a candle or any other shining object, in more mature age is indicated by a love for gems. Although, at present, the value of gems depends solely on their use as ornaments and on their usefulness

as parts of a few delicate instruments, the ancients regarded them in an entirely different light. To gems were formerly attributed the most extraordinary powers; they were believed to be efficacious in preventing disease, in averting all sorts of calamity and misfortune and in frightening away all sorts of evil spirits, gnomes and hobgoblins. It was even believed that a man's fate might be decided by a precious stone carried about the person. Although these views seem absurd and preposterous now, they were thought to be very reasonable then and fully accorded with the spirit of the age. The transcendentalists of those days who insisted that one great Spirit animated the universe, found no difficulty in believing that jewels were possessed of souls, a belief assisted by the extraordinary play of colors and the wonderful sparkling brilliancy which some displayed, both in sunlight and by artificial illumination.

In almost all ages jewels of various kinds have played a part in religious rites. Even so refined a religion as that of the Jews made great use of precious stones in the dress of the priests. Aaron's ephod was ornamented with two onyxes engraved with the names of the twelve tribes, while the breast-plate was set with twelve jewels, which, according to the traditions and to the authority of the most celebrated rabbis and doctors, were the cornelian, topaz, emerald, ruby, sapphire, diamond, hyacinth, agate, amethyst, chrysolite, sardonyx and jasper. The internal evidence of the Book of Job shows considerable knowledge not only of geology, but of metallurgy, and he mentions by name a number of the most valuable gems. The Book of Revelations in the New Testament abounds with references to the various kinds of precious stones, and almost every kind is mentioned in the gorgeous imagery employed by John to describe the new Jerusalem. Astrological mineralogy, properly speaking, had its origin in Chaldea. There first a list of stones was made out, and each assigned its proper healing or beneficial office. In time one gem was appropriated to each sign of the zodiac. Amulets of twelve stones were made so that the wearer could always have an antidote at hand for danger in every time of the year. The garnet was for January, the amethyst for February, the jasper for March, the sapphire for April, the agate for May, the emerald for June, the onyx for July, the cornelian for August, chrysolite for September, aquamarine for October, topaz for November, and ruby for December.

Cardan, a celebrated authority on the mystical properties and virtues of jewels, who wrote as late as the sixteenth century, has much to say of the manner of the origin of precious stones. In his opinion precious stones are caused by certain essences or juices which flow from grosser substances. The diamond, the emerald and the opal he supposed to come from the essence of gold; the sapphire from silver, and the carbuncle, the amethyst and the garnet from iron. He admitted, without question, that precious stones not only lived, but that they suffered illness, old age and death.

"He then speaks of the different virtues possessed by precious stones. The hyacinth preserves from thunder storms and pestilence, and induces

sleep. This quality was attributed to it by Albertus Magnus. Without precisely rejecting this notion, Cardan confesses that he carries ordinarily a very large hyacinth, and that it has never appeared to contribute anything toward making him sleep; but he adds immediately, and with perfect naivete, that his hyacinth has not the true color, and may possibly be far from good. It was also believed that the hyacinth increased riches, augmented power, fortified the heart and brought joy to the soul. He describes the turquoise which, mounted in a ring, secures the horseman from all injury if he falls from his horse; and adds: 'I have a beautiful turquoise which was given me for a keepsake, but it has never occurred to me to test its virtues, as I do not care, for sake of the experiment, to fall from my horse.' Babinet says: 'For all maladies of a nervous or moral nature, where imagination might exert a great influence, precious stones were certainly a sovereign remedy. In saying to such an invalid that an emerald placed under his pillow would drive away melancholy, dispel nightmare, calm the palpitations of the heart, induce agreeable thoughts, bring success to enterprises, and dissipate the anxieties of the soul, a cure was certain to be effected simply by the faith which the invalid had in the efficacy of the remedy. The hope of cure in such affections is the cure itself, and in all the numerous cases where the mind has had an influence upon the bodily system, the imaginary cause must produce a very real effect. Finally, that eternal deception of the human spirit, which registers all the cures, but does not take into account the cases where the curative means have failed of their end, contributed to maintain a belief in the occult virtues of precious stones. It is not half a century ago since sufferers would borrow from rich families gems mounted in rings, to apply to the affected parts. When the trinket was introduced into the mouth as a cure for toothache, sore throat or ear ache, the precaution was taken to secure it by a strong string, lest it should be swallowed by the patient."

The earliest diamond mines were those of Golconda, in India. For many years they furnished employment for thousands of people, and though now they are exhausted, their products glitter in every coronet in the world. In modern times the mines of Brazil have furnished annually $4,000,000 or $5,000,000 worth to the world, and constituted the principal source of supply till eight years ago, when diamonds were discovered in abundance in South Africa.

"The South African diamonds are found over many hundred square miles of territory. The principal diggings are situated in the valley of the Vaal river, to the northeast of the Orange River Free State, and within the boundary of the Cape Colony as now defined. The country here rises into long stony ridges, consisting of irregular fragments of hard rock imbedded in ferruginous gravel, which varies in character and compactness, being sometimes quite loose, and sometimes forming a compact lime-cemented mass. It is in this gravel that the diamonds are found. They occur at various depths down to twenty feet or more, but the usual depth

is from two to six feet below the surface. The manner of work is simple enough. A claim or piece of ground, thirty feet square is occupied by two diggers in partnership, assisted by their black servants. They remove the loose blocks of stone, which are cast aside; they take up the gravel and sift it thoroughly, either in a dry state or with abundance of water in a sieve rocked by a cradle. When the pebbles have thus been separated from the sand they are cleansed and placed upon the sorting table to be carefully examined for any diamonds that may lie among them. The mines were pronounced the richest in the world. Diamonds weighing from twenty to thirty carats were not unusual; and among the exceptional treasures found were diamonds weighing considerably more than 100 carats, including the beautiful 'Star of Beaufort,' and the 'Star of Diamonds,' weighing 107½ carats; and a lovely stone, which attracted especial attention by exhibiting under the microscope an aspect of pointed mountain summits, lighted by vivid sunlight with all the colors of the rainbow."

"One of the most celebrated diamonds is that of the Rajah of Matteen, in Borneo. It was found on that island, and weighs 318 carats. It is shaped like a pear, and is considered by the people of Borneo as a kind of palladium to which the destinies of the empire are attached. They attribute to it the miraculous power of curing all diseases by means of the water in which it has been dipped. According to Jamieson, the Governor of Borneo offered for it $150,000, two large war brigs, with their guns, ammunition and stores, and seventy cannon, with a large quantity of powder and shot; but the Rajah refused to part with it. The story of the celebrated Regency diamond is told by St. Simon, who professes to speak of his own personal knowledge. He says that the diamond was stolen by a person employed in the diamond mines, who escaped to Europe with it, and after showing it to several princes—and among the rest to the King of England—passed over to Paris, and showed it to the somewhat notorious Law. Law proposed to the Regent that it should be bought for the King, but the state of the finances was such that the Duke hesitated to spend such a large sum in that way. St. Simon lent his influence in favor of the purchase, representing that the diamond was peerless in Europe, and would well become the crown of France, and that the purchase of it would shed glory on the regency of the Duke. The latter at last consented, and the diamond was bought for $384,000, others say $648,000, the seller receiving also the fragments resulting from the cutting, with interest on the price till the whole was paid. From that time the Regent became identified with the fortunes of France, and a chapter of historic details belongs to its career. It has passed through many revolutions, and it has passed literally through many hands, for in the days that followed the fall of Louis XVI, the Regent, carefully chained and guarded by gens d'armes, was exposed to the people of Paris, and any half-starved workman who chose might hold this symbol of royal splendor and epitome of twelve million francs for a few moments in his brown hands. The Regent, pawned to the Ba-

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tavian government by Napoleon I, stolen by robbers, and its hiding place revealed at the gate of death by one of the reckless band, and mounted in the State sword of the First Napoleon, finally glittered in the imperial diadem through the palmy days of Napoleon III."

The adventures of the Kohinoor, how it passed from one hand to another, how it was made the pretext for fraud, for intimidation, for murder, and even for war, are all so well known that their recapitulation is useless here.

"When the Kohinoor was brought to England it weighed 186 1-16 carats, and was valued at abont $700,000. At that time it was merely surface cut, and was also disfigured with several flaws, so that recutting seemed advisable; and it was decided to give it the form of the brilliant. The cutting was begun on July 16, 1852, the Duke of Wellington being the first person to place it on the cutting mill, and was finished September 7, thus occupying in all thirty-eight days of twelve hours each. In cutting its weight was reduced to 122¾ carats, but the stone is nevertheless valued at the same price it was before, on account of the improvement in brilliancy and effect. Besides the Kohinoor and a great number of fine pearls, the crown of Queen Victoria contains 497 diamonds, of which the value is estimated at more than $372,000."

"The country most rich in diamonds at present is Russia. Besides special collections of diamonds in the treasury of this empire, there are three crowns of which they form the sole jewels. The first, that of Ivan, contains 881; that of Peter the Great, 847; and that of Catherine the Great, 2,536. Among the large diamonds in Russia the most remarkable is the Orlow. It weighs 193 carats, and is one of the ornaments of the imperial scepter. This beautiful diamond was originally from India. It formed for a century and a half one of the eyes of the famous idol of Serringham, in the temple of Brahma; the other eye was a diamond of the same order. At the commencement of the eighteenth century the idea seized a French soldier of one of the French garrisons in India, to steal the eyes of this celebrated idol. He pretended to be inspired with a wonderful zeal for the Hindoo religion, and gained to that degree the confidence of the priests that they confided to him the care of the temple. He chose his time, and one stormy night, carried off one of the diamonds; the other could not be freed from the socket. He fled to Madras, where he sold the stolen treasure to a Captain of the English navy for $9,300. Conveyed to England it was bought for $55,800 by a Jewish merchant, who some time after sold it to Catherine II for $418,500 and a pension for life of $18,600. A precious stone without rival is the blue diamond of Mr. Hope. Its weight is 44½ carats, and its color is the blue of the most beautiful sapphire, added to an adamantine luster of the utmost brilliancy. It was purchased for $83,700, but competent judges declare that it is worth more."

The classification of jewels by the author arranges all precious stones in three classes. The first comprises a single stone—the diamond—which

is composed only of carbon. The second comprises all jewels the base of whose composition is alumina. The list of these is much more varied than might be supposed, since it contains stones as varied in appearance and color as the sapphire, the ruby, the Balas ruby, the Spinel ruby, the topaz, the emerald, the beryl, the aquamarine, the cymophane and the turquoise. Alumina is the base of the common red and yellow clay which is found everywhere in the utmost abundance, and the only mark of distinction known to chemists between the common clay and the sapphire, or the emerald, is the fact that the latter are crystalized, and contain traces of metalic oxides which give color to the stones. The name corundum is applied by mineralogists to all varieties of crystalized alumina, whatever their color. Colorless corundum is so brilliant as sometimes to be mistaken for a diamond, but it may be readily distinguished by its double refraction, and by its small specific gravity. The corundums are often exceedingly valuable, rubies of perfect luster and purity being of greater value than diamonds. The ruby ranks first for price and beauty among all colored stones. It is of the pure red of the spectrum, and next after the sapphire is the hardest of precious stones, always excepting the diamond. Charles Achard, the highest authority in France in all that concerns the traffic in colored stones, remarks that weight has not the same effect in their case as in that of the diamond. Every diamond, from the very smallest specimen upward has its value, like gold and silver, according to weight; but in the case of rubies and other gems, the little specimens have hardly any value, and these stones only begin to be appreciated at the moment when their weight withdraws them from the common lot, and assures at once their rarity and high price. When a perfect ruby of five carats enters the market, a price will be offered for it double the price of a perfect diamond of the same weight; and if a ruby reaches the weight of ten carats, it will bring triple the price of a diamond of the same weight (from three to four thousand dollars). The carbuncle of the ancients is the same as our modern ruby. The most fantastic qualities were formerly ascribed to these wonderful stones. The carbuncle served to furnish light to certain great serpents or dragons when old age had enfeebled their eyes; they constantly carried these magical stones between their teeth, only dropping them when it was necessary to eat and drink. According to St. Epiphanius, the carbuncle has not only the property of shining brilliantly in darkness, but its light is of a nature so extraordinary that nothing can arrest it, so that it shines, for instance, through vestments with undiminished fire.

Stones composed in whole or in part of silica are much more numerous, and much less valuable than the aluminous stones. Quartz, transparent and colorless, is the purest specimen of silica that can be obtained; and though when colored by the mixture of other ingredients it receives a variety of names, it is no more changed in nature than would be the pieces of the same silk which had received each a different color from dyeing.

"Crystals do not ordinarily attain large dimensions. For the greater

number of minerals, crystals of two inches are almost gigantic; few, indeed, exceed four inches in height. Quartz, however, forms an exception to this rule. Specimens are brought from Madagascar more than twelve inches in length and remarkably pure and transparent, notwithstanding their great size. The rock crystal of this island is used for the object glasses of astronomical telescopes. Magnificent crystals have also been found in the Alps; one of these Alpine crystals, taken in Italy by the French, was borne in triumph to Paris in 1797. There is a beautiful specimen in the Museum of Natural History at Paris, which measures three feet every way, and weighs nearly 800 pounds. At the French Exhibition of 1866, in the sections of Japan and Brazil, there were some wonderful crystals. One brought from Brazil weighs 212 pounds, is 2½ feet high, 1 foot in diameter, and is a perfect six-sided prism. A remarkable phenomenon in quartz is exhibited by the fluid drops contained in many specimens. Sir David Brewster ascertained that the fluid is not water, but of an oleagineous nature, one part volatile at 27 degrees, and the other a fixed oil. Dana has named the former cryptoline and the latter brewsterine. Some beautiful specimens of quartz crystals, beaded with those imprisoned drops, have been found at Trenton Falls.

"Quartz has but little value of its own; but when it is made into vases, cups and other artistic objects, it acquires a high price. The Athenians produced some exquisite works of art in rock crystal, and the Romans valued it very highly in the form of vases. Nero had two cups of it, which he broke in his rage, when he heard of the revolt that caused his downfall. One of these cups was estimated at over $1,900. The *elegants* of Rome were in the habit of using balls of rock crystal to cool their hands, and certain occult charms were also said to reside in these smooth, cold globes. In the middle ages the Venetians produced some beautiful objects in rock crystal; and Milan has long been famous for its statuettes, vases and girandoles of this material. But desire of gain has deteriorated the artistic value of these productions. Cut crystals have come to be sold by weight, and the cutting is naturally falling into neglect. In the Cathedral at Milan the burial shrine of St. Charles Borromeo is wholly formed of plates of rock crystal of six or eight inches square each, set in a framework of silver. The shrine was the gift of Philip IV of Spain, who employed eight years in collecting the necessary quantity of rock crystal."

"When crystals of quartz are found combined with certain traces of coloring matter, they constitute distinct species in commerce, and take completely different names. Combined with iron and alumina, quartz becomes yellow and takes the name of the Bohemian topaz. Impregnated with a bituminous substance it becomes more or less darkened, and is called the smoky topaz. Combined with a slight proportion of oxide of manganese it takes a beautiful violet color; it is then the occidental amethyst. Colored blue by iron and alumina it becomes the water sapphire. Colored rose by iron and manganese, it is the Brazilian ruby. Combined with a notable pro-

portion of oxide of iron, it becomes a brown red, and constitutes the hyacinth of compostella. But among all these varieties, there are only two that are really valuable, the amethyst and the water sapphire. The amethyst of commerce to-day is mostly furnished by Brazil. In that part of the world amethysts attain to an enormous size. A block of amethyst, sent from Brazil to Calcutta, is said to have weighed ninety-eight pounds. Some of the Brazilian specimens are of two colors. Count de Bournon possessed a cut and polished stone of this kind, half violet and half yellow. The ancients believed that wine, when drunk from an amethyst cup, lost the power of causing intoxication. Accordingly the attributes of Bacchus are frequently found engraved upon ancient cups of amethyst."

Under the name of false jewels are comprised three kinds of articles, the first being stones sufficiently hard to resist a file, the second being artificial productions of the nature of glass, and the third being what are called doublets.

"It is of some importance to examine this subject, because there is a prevalent belief that all false stones necessarily have glass as their base, and are consequently of little hardness. People often say when their rubies or their topazes are declared false, 'But, see, here is a file; try to scratch these stones, you will not succeed.' Very true, but submit any piece of quartz to the same test, and the result will be the same. Since, as we have said, hyaline is very abundant in nature, it is easy to procure, at insignificant prices, stones that perfectly resist the file, and show, often in a remarkable manner, the whole series of colors that we admire in real precious stones. The colorless varieties of sapphire and topaz which in density, in hardness and in refractive power differ but little from the diamond, are frequently cut into roses and brilliants and sold for diamonds. A proof of this fact is furnished by the commercial price of the colorless topaz, which is much is much greater than it could obtain as topaz. It is valued in the secret hope that after cutting it may be sold for diamonds. The doublet method of imitating precious stones, though varying in a great many respects, is generally effected by giving the proper shape to a morsel of strass (a peculiar kind of glass), removing from the upper portion of it a certain thickness and replacing this by hard stone, in such a way as to complete exactly the strass stone, then mounting the whole in a setting that completely conceals the line of junction of the two stones. Doublets are of two kinds—in both the under part is strass, but in one the upper part is a plate of the real stone, in the other it is simply hard stone, generally quartz, and of no value. The description of the method of manufacture in the fifteenth century is given by Cardan, who has even preserved for us the name of the inventor. A fraud of a very bad character, and one very difficult to find out, was employed by Zocolino. This venerable personage used to take a thin flake of real precious stone, such as carbuncle or emerald, choosing such pieces as had but little color and were consequently very cheap. Underneath he placed a piece of crystal, sufficiently thick,

and united in two parts by means of a transparent glue, in which he incorporated a coloring matter in harmony with the stone he meant to represent, brilliant red for carbuncle and green for emerald. He concealed the line of junction of the two parts by means of the setting, and to avoid giving rise to suspicion he set them in gold, which was not allowed except in the case of real precious stones. In this way this magnificent workman deceived everybody, even the lapidaries. However, the fraud was at last discovered, and Zocolino took refuge in flight. It appears that this person had a peculiar disposition for fraud, for he turned his attention afterward to the fabrication of counterfeit money, and ended by being condemned to death. An examination of the objects adorned with precious stones that were executed in the middle ages, shows that the process described by Cardan was not unfrequently employed."—*Globe Democrat.*

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## MICA AND ITS USES.

Mica, from the Latin "to shine," is composed of silex, alumina, and potash. It is found in almost every country on the globe—America, Switzerland, Siberia, Norway, Bohemia, and Russia. Siberia and the United States probably furnish the best and largest specimens. It occurs in granite and quartz, also in rubellite, green tourmaline, feldspar, lepodolite, and several other minerals. It is one of the constituents of granite, gneiss, and mica schist, talc-slate, etc. It sometimes occurs in granular limestone, and rarely in lava, dolomite, and magnetic iron ores. According to Dana, mica is usually in thinly foliated plates or scales; color from white, through green, yellowish and brownish shades, to black; with a pearly lustre, transparent or translucent; before the blowpipe infusible, but becomes opaque white. There are a number of varieties. That in which the scales are arranged in plumose form is called plumose mica; that in which the leaves or scales have a transverse cleavage is called prismatic mica. The crystals are chiefly rhombic, or six-sided, though not always. The cleavage of mica is highly perfect, and, according to Professor Henry, it can be split or divided into leaves 250,000 to the inch. It shows a tendency to associate with quartz, and in the mines recently discovered in New Mexico a coarse quartz mixed with fine white crystal formation is the sign of the mica mine. Many deposits or veins have been discovered in San Juan during the winter, but a very small per cent. carry mica of a merchantable quality; the cleavage is generally transverse, or foreign coloring matter enters into it to such an extent that it is worthless for market. The uses of mica are various. Diamond dust, with which court dames and our own American ladies powder their hair, is ground mica. The costly French silver mouldings are cast from ground mica. The wonderful showers of diamonds I have witnessed in the scenic plays of the "White Fawn" and the "Black Crook," at Niblo's, were mica scales. As a lubricator it is pertection. Mixed with

oil it wears longer than any other ingredient. Recent experiments have shown that for any swift-running machinery, where the Babbit metal and other packing have proved at fault, mica packing is perfect; being indestructible by heat, it generates none, and as soon as a good Yankee test is made, the result will be mica-packed boxes for fast, heavy-running machinery, and no more hot boxes or worn journals, being entirely free from grit. For stoves it has now become indispensable, and the demand for clear, transparent mica is rapidly increasing. We have opened five mines during the past three months, and out of over forty veins which I have examined since last November, these five are the best. The quantity which these mines can produce is unlimited, and the quality equal to any in the United States. I have carefully compared it with mica from the mines of North Carolina, of S. Royalston, N. H., and of Paris, Maine, where mines are now being worked; from what I learn of mines in other parts of the United States and over the water, I am led to believe that we have a much larger deposit and of larger sizes than is now found in this or any other country. Large plates, when they could be procured, were at one time used in the Russian naval vessels for deck or dead lights, because not liable to fracture from concussion. It is in common use for lanterns, and is rapidly coming into use for lamp chimneys. On account of its transparency and toughness, and the thinness of its folia, it has been used as glass in Siberia, but is now too costly for common use. It is not difficult to find mica in the district in which our minerals are located, but after many months spent in prospecting, exploring, and working, I find that to find the perfectly clear, transparent, flexible mica, free from color, veins, curves, and other imperfections, is very difficult. Sizes as large as 14 inches have been found in North Carolina. We have not unfrequently sized from 18 to 24 inches. Last week we took out one book or crystal weighing fully one hundred pounds. We are now able to furnish mica by the ton. Crude mica, *i. e.*, pieces too small for cutting, and the cuttings are too far from market, and the uses of waste mica too limited, to render them valuable. Sizes less than $2\frac{1}{2}$x4 or $4\frac{1}{2}$ inches are hardly worth saving. Sizes 5x7 and 9 inches are worth $6.50 to $7.40 per pound, with a rapid increase in price for larger sizes. I made an extended tour of observation through New Mexico with Governor Hunt and Colonel C. B. Lamborn, of the D. and R. G. railway a few weeks ago, and returned to our mines fully satisfied that the small district in which we are now operating contains about all there is worth looking for in that line in that territory. Small deposits or veins are often found at a distance from us, but after a thorough investigation and an expenditure of labor and money, have been abandoned, the quality not proving satisfactory, The mica which I have so far exhibited from our mines has all been taken from within one to three feet from the surface.—J. CARY FRENCH.—*Journal of Applied Science.*

## ARGENTIFEROUS MUD.

The report made recently that in the Lake District of the San Juan mining region there had been discovered a yellow mud lying in a crevice in the pay streak, about an inch and a half wide, which assayed from one hundred to four hundred dollars in gold, and from two hundred to two thousand dollars in silver per ton, recalls and gives plausibility to the statement published in the San Francisco *Examiner*, within a few months past, that in Wasco county, Oregon, there is a flat thickly studded with springs of a peculiar character, that throw out mud which has overflowed a considerable area. Some months ago it was reported that this mud had been discovered to be argentiferous and very rich, some specimens assaying over $2,000 to the ton. Prof. Hanks intimates that the flow of the Oregon mud springs is in reality heavily impregnated with silver, and this result he announced in a paper read before the California State Geological Society last Tuesday evening. The existence of springs yielding soft mud, charged with free silver, says Prof. Hanks, is new to science, and scientific men, both here and at the East, who examined specimens, pronounced them fictitious without hesitation. The specimens latterly examined by Prof. Hanks, he says, were very rich, and silver was discovered in a free state. By simple washing the silver could be wholly separated, and when then examined the microscope failed to reveal the source of the precious metal. Had it been filings, a single glance would have sufficed to detect the fact. Had the silver been precipitated from solution by copper it would have been crystalized. An amalgam of silver and mercury would have yielded a sublimate if strongly heated in a glass tube closed at one end. Such an amalgam introduced into the wet mud, and the whole heated sufficiently to have volatilized the mercury, would have left the substance in a hard, baked state, which could not again have been reduced to the state in which it reached this city. From these conclusions, if the silver had been introduced for fraudulent purposes, the substance was very remarkable, from the fact that some process had been employed not easily understood. Prof. Hanks finally obtained the address of a gentleman represented to him as being of unquestioned character, Richard Hurley, residing in the vicinity of the wonderful springs in Wasco county, and applied to him for information. In reply to Prof. Hanks, Mr. Hurley writes: "There is no mistake as to this mud containing silver. I have assayed over 100 samples which contain silver, some as high as $2,300 to the ton. The samples I obtained from the springs myself. I think the weather has considerable to do with the mud containing silver. I obtain the best results when the weather is warm. Sometimes in one of the larger springs, when the weather is cold, the mud will be of a yellow color, showing no silver, but when the day is warm the mud is blackish blue, at least in places, and rich in silver. They seem to work more actively in a warm afternoon. Some of them contain a great

deal of acid, the bones of animals that fall into them being dissolved in a few months. There are old wells which assay from $5 to $1,200 to the ton. One assay I made from the flat, half a mile from any spring, assayed $1,200 to the ton. There is a great deal of salt, almost pure, all over the spring flat. There are between 100 and 200 quartz leads discovered, running in two directions, close to the spring. I find silver in several of them, all the way from a few dollars to $100 to the ton. Some of these leads run through the springs, at least they point in that direction. The altitude of this place is between 4,000 and 5,000 feet."

Prof. Hanks also refers in his paper to the recent discovery of a peculiar silver-bearing deposit located in Southwestern Utah. It occurs in the "Maud Mine," six miles from Leeds. Some assays as high as $700 per ton have been made. Instead of being sandstone, as supposed, Prof. Hanks found the deposit to be sedimentary, but closely resembling the Oregon mud. Under the microscope it has all the appearance of that strange substance. The Oregon mud, if allowed to dry in large quantities, would soon form a similar substance to the Utah mineral, in appearance at least. The silver is in the state of chloride, and is seen under the microscope both amorphous and in crystals. An analysis of the two minerals will be interesting, and may throw some new light on the subject. It is possible that a study of these deposits may contribute much to our knowledge of the formation of metalliferous veins.

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## THE MINERAL WATERS AND BATHS OF CHILE.

The *Edinburgh Medical Journal* has an article by Dr. John Boyd on the "Medical Society of Chile," in the course of which the following account is given of the medical springs of the country:

*Mineral Waters.*—Chile possesses a great number of mineral and thermal waters, but only a small proportion of these has been utilized for the benefit of the sick. Almost all of them are found at the foot of the Andes, or on its declivity; the most celebrated and most frequent being the following:

1. *The Baths of Chillan*, situated at 1,864 meters above the sea-level, in a volcanic region, little distant from the perpetual snows. Of its various affluents, the most important is the sulphurous, the temperature of which reaches 58° (136.4° Fahr.). From their high elevation, these are only accessible during the summer months, and the accommodation for patients is middling. In other respects, the access is sufficiently easy.

2. *The Baths of Cauguênes*, on the banks of the river Cachapol, and at 677 metres above the level of the sea. They are alkaline waters, varying in their temperatures in the various springs from 35° to 47° (95° to 116.6° Fahr.). The establishment can vie in every respect with the most celebrated in Europe.

3. *The Baths of Apoquindo*, a few leagues to the east of Santiago, at a height of 799 metres. They are equally alkaline, although less concentra-

ted, and the different streams have a temperature from 17° to 28° (62.6° to 82.4° Fahr.). At these baths may also be found every accommodation for the infirm and other visitors.

Equal convenience may be found at the baths of *Colina*, situated at ten leagues to the northeast of Santiago, at an elevation of 909 metres. The temperature of the waters is from 25° to 32° (77° to 89.6° Fahr.). This contains a quantity of alkaline principles in solution; they are nevertheless very efficacious in certain maladies.

In all the other baths, which, from their chemical composition, might be even preferable, there has not been the slightest trouble taken to gain access to them easily, or to supply the means of lodging or living there with any comfort. It is necessary to bring all sorts of provisions, beds, etc., with one, to erect a hut or cabin, and to bath in the open air. Hence it arises that, with few exceptions, only the inhabitants in the vicinity of these baths make any use of them or have any experience of their medical virtues.

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# METEOROLOGY.

## THE STORMS OF JUNE AND JULY, 1877.

(COMPILED BY THE EDITOR.)

Within the past six week unusually severe wind storms have prevailed in different portions of the country under circumstances so different and exhibiting such peculiar phenomena that it seems impossible to reduce them to any system or classify them under any law hitherto suggested by either Redfield, Peddington, Reid, Espy, Peslin, Faye, or Tice.

Without attempting to establish or support any theory regarding such phenomenal occurrences, we will briefly quote from that of the distinguished physicist, Faye, of Paris, which differs materially in many respects from those of the earlier writers:

"*First*, cyclones, hurricanes, typhoons, tornadoes, and waterspouts are phenomena of one and the same mechanical nature, and to all of which the same general explanatory theory will apply. *Second*, since the eye can embrace the two latter phenomena in their totality, while the other three classes of storms are spread over too vast an extent of territory for any one observer to seize all their features directly, therefore we ought at first to begin our discussion and investigation with the consideration of tornadoes and waterspouts, at least if we desire to base our conclusions upon facts only. *Third*, the greater part of meteorologists attribute these phenomena to a vertical aspiration, whose existence they gratuitously assume at the commencement of their investigation. Under certain statical conditions of

the atmosphere this aspiration can, according to them, develop mechanical effects of astonishing power. According to them the gyration which is so characteristic of these storms is only an incidental matter, resulting simply from the reaction of the ground upon the horizontal currents, that ground being animated by its slow daily rotation. This reaction, which changes by only 40° the direction of the lower trade-winds in their long course, is made to describe many circumferences in the space of a few yards and in the interval of a few seconds, in the course of these pretended horizontal currents, whose existence not a single observer has as yet noticed. According to the theorists, these latter converge violently from all sides toward the lower orifice of the waterspout or the tornado, in order then to spring vertically through this narrow orifice up to the region of the clouds under the form of a column, surrounded by vapors condensed by cooling, and spreading as they ascend. *Fourth*, on the contrary, I submit that the common origin of all these phenomena is found in the upper currents, whose power and directions are clearly shown to our eyes by the clouds, and not in the lower strata, where an almost perfect calm continually reigns. Not, of course, that a calm reigns at the precise spot where the waterspout exists at any moment, but all about it. Upon this capital point, so easy to demonstrate, so frequently denied by observers, and which lends so much to the solution, all the witnesses are agreed. This does not prevent the aspiration theorists from placing violent currents, like immovable layers, around the heart of this perfect calm, which the waterspout or the tornado does not disturb for an instant in its rapid course. Never have we seen in science a similar disregard of facts; a strange indifference which is explained only by the influence of a very ancient and very extended prejudice, whose history I have traced in the *Annuaire* for 1875, and which has caused meteorologists to replace facts by theories upon the stability or instability of atmospheric equilibrium."

We will now mention several of the more notable storms of the month of June or July, and as far as practicable point out their striking peculiarities.

One of the most severe, though exceptionally local in its character, was that of June 4th, which visited and nearly destroyed the town of Mount Carmel, Illinois. Mount Carmel is located on a plateau at an elevation of about 75 or 80 feet above the Wabash river, and about three-fourths of a mile west of that stream.

Prof. J. H. Tice, of St. Louis, visited this place about two weeks after the passage of the tornado, and we avail ourselves of the information obtained by him from eye witnesses:

"The streets run parallel to the river or rather to the bluff on the east side of the town; hence do not conform to the meridian and parallels of latitude. Main and its parallel streets run from about fifteen degrees west of north toward the same numbers of degrees east of south. Consequently the cross streets, Fourth, for instance, at right angles to Main street, run

from fifteen degrees south of west to the same number of degrees north of east. The bluff, southeast of the town, turns a right angle to the westward, hence all streets terminate at right angles on the bluff. The tornado came nearly from the southwest or about on a direct line with Fourth street, which it followed centrally from end to end, throwing out spurs occasionally that demolished buildings and did considerable damage on adjacent parallel streets. It has been ascertained that the incipient formation of the tornado took place in White county some eight miles north of Carmi and some thirty miles distant from Mount Carmel. It there demolished a house and wrought some other mischief. It made long leaps and dipped down several times before it reached Mt. Carmel, but it probably would have passed without doing much if any damage if it had not been reinforced by a heavy column from the eastward. This column, in the form of a funnel, was seen by Mrs. Turner, who lives on the street fronting the bluff south. She is a lady of more than ordinary intelligence, and well posted in meteorological matters, having a son in the Signal Service stationed at Bristol Bay, Alaska. This cloud she told me was dark green :—very ominous, since this color indicates hail, and its funnel form a tornado. This cloud moved westward behind the shade trees that line and adorn Front street on the brow of the bluff, where she lost sight of it. But she said it sent off a well defined tornado that swept up the bottom between the bluff and the railroad bridge that spans the Wabash here; and pointing out the trunk of a large prostrate sycamore, she said: "It threw that down before I heard the roaring of the tornado in the southwest." Mr. Charles Ridgeway, station agent at the depot, saw this cloud coming from the east, meeting a similar cloud from the west, and immediately a spout shot down with fearful velocity toward the earth. Judge T. J. Shannon's residence is west of the depot and about a quarter of a mile north of the railroad on high land.

Mrs. Shannon's statement, furnished to me in writing, is this: "I was standing at my sitting-room window watching the approaching storm, when I saw two heavy clouds meet; and instantly heard a loud roaring. I thought a long train of cars were coming at full speed. I soon discovered it proceeded from the cloud now looking very singular and whirling at a rapid rate with shingles, planks and timber flying around in it. It appeared not more than fifty feet in diameter at the bottom,* widening towards the top. I do not think it could have been more than 75 to 100 feet in height, and in form nearly funnel shape. Its forward motion was from west to east, and seemed to follow a straight line as though a track for it to pursue had been marked out for it from the woods near where it first struck towards the town. It whirled towards the north.† It snatched up

*1. The area swept by it, however, averaged three hundred feet wide. Mrs. Shannon's point of observation was fully three quarters of a mile distant. This accounts for its apparent diminutive size. This also was at the time it struck the first house, fully a mile and a half from town.

†2. This statement being indefinite, I called her attention to it, and asked what she

every thing in its path. When it struck the main point in town I discovered that it moved up and down and tossed about some.* The cyclone was shaded alternately in light and dark streaks, looking very much like smoke and steam thrown from an immense engine."

The next person that saw it from the north side was Mrs. Jacques. Her residence is three squares north and two squares east of Fourth street, the street ravaged by the tornado. Her view was obstructed some by the dense row of shade trees on the south side of the street. She says the clouds were intensely black, shaded with streaks almost snow white; that the shape of the cloud was that of an immense funnel, through which things were ejected upward in a whirling motion contrary to the hands of a watch, consisting of roofs, houses, timbers, shingles, boards, and everything gathered in its course, while the things thrown out at the top were in many cases drawn in again below. This is in accordance with Mr. Wise's balloon experience. Seven times was he drawn into and thrown up through the vortex of a hail storm, then thrown out at the top, and while descending drawn in and thrown up again. I and others have observed this action in vapor during a tornado, but this is the first time as far as I know that solid matter has been observed to behave so. That such was the case in this instance, is evident from the fact that the three little school girls who were snatched up near the school house on Fourth street, saw the Methodist church steeple away below them. After being carried 1,100 or 1,200 feet they were for an instant deposited in a mud pond, then snatched up again and carried 600 feet further, where they were left unharmed, except soiled clothes and badly frightened. I could not find any one on the south side of the storm's track who saw it; probably because the ground was not very favorable for observation, the view being obstructed by the dense foliage of the beautiful sugar maples that line the sidewalks of the charming city.

Mr. Valentine Smith, who saw it in front and approaching until it was within a hundred feet of him, and whose house was partly demolished, in substance gave me the following statement:

His place of business is on Fourth street near where the court house stood, five or six doors north and on the east side of Main street, nearly op-

meant. She stated that she meant that things whirled on it, moved from west by way of north thence east. I informed her that this was impossible, that this would be the cyclonic whirl of the Southern Hemisphere, and that in the Northern Hemisphere the whirl is invariably from east to north, thence west, etc. She however insisted that it was as she stated it. But she is laboring under an optical illusion; the scattered debris of houses destroyed in its path unmistakably shows the whirl to have been from east to north thence west, or normal for the Northern Hemisphere. The prostrate trees on the Indiana shore, near White River, establish this point beyond question. I invarably found the first trees prostrated, that is those at the bottom, fallen either from the south or east. Upon these lay in succession those fallen from the northeast, then those from the north, ending with those from the west on top.

*3. The *ricochet*, however, is evidently from the beginning. After destroying the first house it leaped a barn directly in its path, and completely wrenched off the top of an elm tree not fifty feet beyond the barn. There is evidence that it hugged the ground continuously, or nearly so, from the time it leaped the Airline Railroad and struck east of it, to Main street or perhaps the Methodist Church. Then there was an independent stroke to the right and soon after a terrific one on the main line again.

posite to where Messrs. Biddle & Keneipp's large brick store was demolished. He said: "Finding a storm was approaching I ran up stairs to close the windows. Hearing a terrible roar and continuous explosions like rapid musketry firing during the war, I looked out and saw the tornado coming up Fourth street. It was very black with white streaks like steam in it but the heart of it was fiery red like a flame. I thought Mr. Biddle's house was on fire, and that the tornado was sucking up the flame. An instant more and it was as though a huge wave had struck a ship and the wall of the house flew out as is it had been shot away by a cannon." Mr. Sebastian Seller, whose dwelling on Fourth, east of Main and beyond the Methodist Church was utterly demolished and his garden desolated and ruined, makes the following statement, so I was informed by credible persons. I was unable to see him myself for want of time, the information reaching me too late. His description of the cyclone accords with that of all others, with this addition: "It looked like the burning of dried leaves in a green brush heap; there were bright dancing flames all through it." Since these witnesses were nearer than any others to it, and since they had an unobstructed view of it, it is not at all surprising that they saw more than any one else saw.

The fire or flame they saw in it is not unusual. It is found graphically described in the first chapter of Ezekiel, in the whirlwind described by the prophet. Mr. Tooley who described the tornado that occurred at Natchez May 7, 1840, by which 317 persons were killed, says it was of a lurid yellow. Chappelsmith who described the tornado that occurred at New Harmony, Ind., on April 30, 1852, says, "the cloud appeared on fire at the bottom, like a large pile of burning brush; others say it was a cloud with green and red flame, and others with green and blue flame. Mrs. Bissell, and others, who saw the lowest point of the cloud spout that caused the tornado in St. Louis county on the 29th of July last, say it was tipped with a fiery mass as large as a barrel bowling along like a huge ball.

Sergeant Henry Calver, whom I had the pleasure of meeting at Mt. Carmel, who investigated the tornado of Georgia and South Carolina that occurred on the 20th of March, 1875, in his report to the Chief of the Signal Service, says: "Dr. Charles Biddle states that it presented all the colors of the rainbow, sometimes with considerable yellow, and again with the appearance of fire." Several other persons corroborated Dr. Biddle's statement, as to colors and fiery appearance. The accompanying noise was a heavy roar, and as it approached nearer a crackling noise was distinctly audible. Mr. Calver adds, "the last mentioned sound may have been caused by electric discharges, as it would hardly be possible to distinguish the noise made by the breaking of trees, etc., at the distance of two miles or more." This fiery appearance of the cloud in the same report is stated many times and by witnesses at far distant localities, but I have not time for more quotations

Many of the trees, and nearly all of those on the Wabash bottom, are seared as though a flame had passed through them. I was informed that the

leaves had this appearance immediately after the storm. Tooley says of the Natchez storm, "the effects of the storm upon the leaves and buds of plants was to sear them so that they crisped. Some very thrifty grapevines were entirely killed—even the succulent *morus multicaulis* appeared as if an Eastern sirocco had passed over it." The same phenomenon has been often observed in different localities as attending tornadoes. A sufficient cause must exist that produces it. * * * * * *

Upon the hypothesis that it is electricity, we encounter no difficulty in the way whatever, provided we are familiar with electric laws, and versed in the principles of electric science. * * * *

Two great principles are only necessary to be mentioned here: 1—That any insulated matter when charged, will by induction evoke an equally potent charge of the opposite electricity upon the nearest point of adjacent matter, instant communication between these two opposite points taking place, so that these charges mutually obliterate each other. The earth always is negative and the clouds positive. Hence a cloud in proportion to the intensity of its positive charge evokes from the earth beneath it an equally intense negative charge, even though the latter were devoid of negative electricity. Hence communication between the earth and the cloud is instantly established in order to obliterate the charge on the cloud. The tornado is the effect of the act of communication, thus established. 2—The other principle is that electricity cannot pass between two points except by one of two ways, (1) by conduction where the two points are connected by continuous matter; and (2) by convection, where the points are insulated or where the matter is discontinuous. Those who have any doubt about this may consult the works of the late Professor Magnus of Berlin, or those of Professor Schelen of Cologne, the world-renowned spectroscopist. The latter says: "The electric current requires a material conveyor for its transmission from one point to another. It cannot pass where there is no trace of either gas or vapor." He might have stated that where there is neither a trace of gas or vapor in contact with, or free matter upon the discharging pole to give electricity convection, it improvises a conveyance by disrupting matter from the pole, whether that pole be of metal or any other substance and throws it across the intervening space upon the other receiving pole.

The hurling of matter into, and up through the vortex of the tornado is hence only a discharge of electrified matter conveying electricity from the earth to the clouds; the gravity as it is called of the matter affected being overcome by the attraction of the cloud above which gives it a pull in front, and the repulsion of the earth below which gives it a shove in the rear. This action can be simulated in the laboratory. Paste a piece of paper upon any good conducting substance and pass a charged conductor rapidly above it; as the conductor passes by, the more rapidly the better, the paper instantly leaps upon it. This principle explains the whole mystery of electric action in the tornado.

XUM

The reader must now be qualified to comprehend the singular action of a tornado. This one like all similar tornadoes passed through a calm air. At the railroad depot during its passage the air was perfectly calm and still, followed a few moments after by a sudden strong wind from the opposite quarter. Its passage was too rapid for the surrounding air to be put in motion. Had time been given for the air to rush in, no houses, trees nor other matter would have thrown themselves into the vortex. In other words no effects would have manifested themselves otherwise than a strong whirlwind. Persons in the track of the cyclone were astonished to find such instant and terrible effects occur with so little wind in the front of the storm. Trees showing scarcely any agitation were seized as by a herculean hand and instantly jerked into the approaching storm center. The bell on the court house was instantly thrown 100 feet across Main street directly in the teeth of the storm. A frame house near where the bell fell leaped five feet back from the street and also in the face of the storm. Roofs and the west walls of houses jumped into the approaching vortex. On its south flank the south walls did the same. East walls and roofs and sections of roofs, threw themselves into the retreating vortex. West of town there stands a pecan tree about 20 inches in diameter; from appearances it stood very near if not quite in the center of the vortex. The bark, except two small strips, one of which, however, is completely detached from the trunk —shot into the passing vortex. The evidence of electric action here is unmistakable. The way that the bark was wrenched off shows that the force came from the tree as a center. On the west side, the tree split into a thin slat not one fourth of an inch thick. A section of this slat, about three quarters of an inch long, is cut out as though a bullet came from the center of the tree. Mr. Landers, who accompanied me, probed the depth of the orifice. A small twig could be run in without difficulty to a depth of $2\frac{1}{2}$ inches. The tree stood in a grassy plot. All around the tree the sod was thrown out three inches in depth, exposing the roots, showing an electric charge coming from the roots. Philip Stein's blocks on which his stable stood that went up in the vortex, show the same fact. The blocks were buried to within an inch of the top. The soil is also shot away around them to a depth of three inches. They were double blocks about 14 inches in depth. At one corner both blocks were shot out; the upper one I left on the ground, but the lower one went no one knows whither, because it has not been found.

Into the overhanging vortex, houses, roofs and everything free on the earth below leaped perpendicularly. Mr. Lewis Gott, who was a square north from where his new and unpainted house stood, and in which he lived, hearing the roaring sound in the direction of the new house, saw it go up bodily and plunge into the cloud; that is the last seen or heard of it, for not a fragment of it nor of anything that it contained has yet been found. Mr. Solomon Kneipp saw the store building, a strongly built brick, two stories high, and 43 by 20 feet, lifted up from the floor so that he could see

out under it on two sides. Then suddenly everything came crashing down burying him, his partner, Mr. Moses H. Biddle, and others.

The steeple of the Methodist Church on Fourth, east of Main, was torn off and broken in two. The lower half was ripped asunder and thrown in opposite directions. The upper half was carried upward and no vestige of it has been found.

A sack of flour from a demolished store on Main street was carried five miles beyond the Wabash into Indiana, Except a small slit—cut perhaps by some flying missile—it was uninjured. Debris has been found for fifteen to twenty-five miles in the track of the storm in Indiana. Letters have been found fifteen miles north of Vincennes, or forty miles from Mt. Carmel.

I saw several houses, Mr. Steitz' amongst the number, that were lifted and twirled, and then set down. The most curious fact observed at Mr. Steitz' was that a portion of the brick wall, two bricks in depth and about ten feet long, adhered to the sill of the house, a frame, and was carried with it in its twirl. The house has since been shoved back, but the aforesaid portion of the brick wall marks the line where the house had been set down.

Many evidences also exist here of the hurling phenomena of tornadoes. In Mr. Joseph Harris' house, a block or so east of Main, on the north side of Fourth, a brick was hurled at an angle of not more than ten degrees with the horizon through the wall of the house, passing across two rooms, and breaking through the studding and plastering of the rear wall, without breaking the brick. A small fragment of a brick came through a window and cut the carpet as if done with a knife. At Philip Stein's I saw two rafters hurled forty-eight inches into the soil. One broke off about three inches above the surface of the earth and was hurled against a pannel of paling fence, which it knocked down."

On June 23d a violent tornado struck St. Joseph, Mo., coming from the southwest and destroying and damaging a large number of buildings. The same storm also did considerable damage at Leavenworth City, Kan.

On June 25th a very heavy wind storm, originating probably in Colorado and extending over a width of not less than three hundred miles, passed over this city at about half after six in the morning, and resulted in a general hurricane as it proceeded eastwardly with increasing velocity as far as central Ohio. Reports from points all over Missouri, Iowa, Illinois and Ohio, together with some from Southern Wisconsin and Kentucky, show it to have been extremely violent and destructive. Buildings of all kinds were demolished, and at different points railroad trains were blown from their tracks and many lives lost. It was accompanied with rain in many places and by hail in others. It was probably more general in its character than any that has occurred for several years. At the time of its passing this city it

was not regarded as more than a brisk gale, but between here and Chicago it reached an average velocity of nearly 50 miles per hour, between here and Cincinnati a velocity of 52 miles per hour, and between here and Columbus, O., an average of 57 miles per hour.

On Saturday evening June 30, a severe tornado, originating in the State of Illinois a few miles east of St. Louis, Mo., struck the town of O'Fallon and nearly destroyed it. Its approach and unusual action are thus described by an eye witness:

"Light colored, but heavy clouds, had at intervals during the day obscured the sun. In the afternoon, dark cloud banks rolled up from the northwest. The atmosphere became sultry and oppressive, and was heavily charged with electricity. The dimness of twilight fell over the landscape. Fitful flashes of lightning in the west were accompanied by low rumbling thunder. The storm at last took position, heaven's artillery was wheeled into line, as it were, a flash of lightning of great brilliancy was seen, and the forked tongue of the shaft launched downward. A monster oak in a grove one mile west of the little town was riven by the stroke. A deafening clap of thunder followed. The flood-gates were opened, and the rain poured down in a deluge, while the lightning flashed and the thunder rolled with a frequency that was almost horrifying. The tempest abated. The streets were filled with water. Some few people ventured out. The tempest had passed almost due east from west. Those who looked out after this lull saw that it was raining off towards the northwest. A loud noise was heard, like unto the rumbling of a train of cars crossing a covered bridge. The rain in the northwest advanced in a southwesterly direction toward the town. Heavy clouds, which, from time to time emitted sullen electric flashes, scudded before the wind from east to west.

The clouds from the northwest continued on their course, the angry roar growing louder as the storm approached. It struck the path of the tempest. There was a strange commotion. The clouds were seen to bubble and boil violently, the appearance being that of vapors struggling to liberate themselves. In an instant a cone-like form was assumed, and as if directed by some revengeful spirit omnipotent in the air, the cyclone darted toward the earth, striking the ground at a point a half mile due west of the town. A small frame building, owned by A. C. Jones, was seized in the grasp of the destroyer, and the fragments went flying through the air. Unlike the Mount Carmel cyclone, this one did not follow any especial route, nor did it make a clean sweep before it. It bounded from right to left into the air and back again like some wounded thing. Whatever it touched it destroyed. It would make a bound and a swoop, and some substantial building would fall in ruins, while some fragile structure a few yards away would remain unharmed. Stables were overturned, while residences within twenty feet would be passed unscathed. At times the thing, seemingly not satisfied with its work, would go back upon its track and destroy something left in safety before. It passed on through the town,

and was next heard of two miles east, where the roof of the home of the Widow Westfield was taken into the air and carried hundreds of yards. It then made a detour to the southeast for the purpose of wrecking the house and barn on the old Thomas place, finding time in the same connection to severely, and probably fatally, injure Krost Thomas, a youth of eighteen. Making a leap to a barn a half mile due east of the Thomas place, which it succeeded in unroofing, it made a bee line for Lebanon, just six miles east of O'Fallon, uprooting trees and ruining wheat and cornfields *en route*, where the spire of the Methodist Church succumbed, as did several small shanty structures. At Lebanon the presence of the tornado was marked by one of the severest hail storms ever experienced in that locality. The storm continued on its eastward course, making a number of devastating calls." This same storm seems to have passed onwards in a northwesterly direction, skipping over the State of Illinois and crossing the States of Indiana and Ohio into Pennsylvania, and doing great damage at Mooresville, Brooklyn, Columbus, and St. Paul, Indiana; Springfield, Mount Vernon and Zanesville, Ohio; Parkersburg, Ercildoun and Coatesville, Pa. It is described as being from half a mile to two miles in width, and in most places was accompanied with a very heavy fall of rain.

On the morning of July 1st, between eight and nine o'clock, a storm, which is described as the "most destructive ever witnessed in Eastern Indiana," devastated the section of country between Middleboro, Indiana, and New Paris, Ohio. It is stated as a remarkable feature of this case, that "two wind clouds, one above the other, rolling in northwesterly and southwesterly directions, produced a whirlwind."

On July 7th a terrible whirlwind struck the town of Pensaukee, Wisconsin, twenty-five miles north of Green Bay, on the Chicago and Northwestern R. R., leaving but three houses standing. The storm came from the northwest, and passed on southeasterly, destroying the town of Coullardville in its course. Its track was less than eighty rods wide, and its force was expended in two minutes.

On July 9th a heavy storm of wind and rain passed over northern New York and Canada, destroying many buildings as well as crops and fences.

Numerous other local storms have been reported, both North and South, but the most important ones have been given above.

The storm theories of Prof. Tice are sustained to some extent by the observations of Father Secchi, who, in writing to a friend in Belgium, alludes in striking terms to the remarkable connection between the magnetism of the earth and the changes of the weather. He says that the variations shown by the magnetic instruments are themselves sufficient to indicate the state of the sky. Even where there is no great movement of the barometer, following such magnetic disturbances, there are, especially in summer, changes of the wind and sometimes storms.

In this connection we copy from the Kansas City *Journal of Commerce*,

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of July 15th, a condensed statement of a new theory in relation to tornadoes:

"The Signal service has given us a new fact in relation to tornadoes which has given rise to a theory that may lead to another link in the chain of investigation respecting the law of these terrible visitants.

"Its nomenclature is borrowed from the railway, and termed the thermal gradient. Take for example the late tornado at Pensaukee, Wisconsin. At the time of its occurrence a steep thermal gradient prevailed between the Mississippi and Lake Michigan—in length about one hundred and fifty miles. At La Crosse the thermometer stood at 95° and at the Pensaukee end it was 65°, a difference of 30°. This condition, it is claimed, with the difference in the atmospheric density and humidity, furnishes the conditions necessary to develop the tornado.

"The character of the movement is a violent rupture of the superincumbent strata of dense cold air by the highly heated surface stratum. In the effort of the latter to expand and obtain an outlet it acts like steam when confined in a boiler. If this is correct, the greater the difference in temperature between the points on this thermal gradient, the more violent will be the atmospheric explosion.

"The gradient in the case of the Pensaukee tornado, was a descent in the temperature of 1° for every five miles. A tornado then under this theory was inevitable. Whether the theory is a correct one, is open to discussion, but the fact is not, and therefore valuable, because it is from the accumulation of facts that the law will ultimately be established."

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## THE PERUVIAN TIDAL WAVE.

(COMPILED BY THE EDITOR.)

On the 10th of May, 1877, a great tidal wave brought destruction to many thriving towns along the coast of South America, and especially along that of Peru. The appearance and effect of this wave is well and fully described in the extracts given below from various local papers, but there seems to be some disagreement among observers and theorists with regard to the origin or starting point of the wave itself. The journalists of San Francisco seem to attribute it to an earthquake occurring on the evening of the 9th of May, resulting from an eruption of the volcano Ilaga, situated on the southern borders of Peru and Bolivia, while a writer in the *Christian Union*, from the Hawaiian Islands, connects it directly with an eruption within the crater Kilauea, and a subterranean upheaving of the water in Kealakeakua Bay. On both coasts at about the same time violent shocks of earthquake were felt, great disturbances of the ocean were observed, and immediately following came immense waves, varying at points along the South American coast and that of Hawaii from five to sixty-five feet in height, which swept away or seriously damaged many towns and destroyed thousands of lives.

One of the most remarkable circumstances connected with these phenomena is the rapidity with which such shocks are borne by the waves across immense stretches of oceanic space. One thousand miles an hour is not regarded as an unusual rate of speed, and, as will be seen below, the transmission of the tidal wave under consideration approximated this rate between the Sandwich Islands and San Francisco.

The vast distances that such waves are projected are quite as remarkable as their rapidity of motion. From a central point on the Peruvian coast, say Iquique, to Hilo on the Hawaiian coast cannot be less than 5,000 miles, probably more, and the wave seems to have traversed this distance within the space of ten hours from the date of the earthquake. At the time of the destruction of Lisbon, in 1755, the marine wave resulting from the shock was carried to a distance of nearly 4,000 miles, striking the shores of America before stopping.

In 1854, at the time of the earthquake of Simoda, Japan, the wave that reached the coast of California had traversed the entire width of the Pacific Ocean.

The following descriptions of this wonderful but disastrous phenomenon have been compiled from various local papers, and probably give reliable details. *Harper's Weekly* gives the following condensed statement:

"From the Peruvian coast there comes a thrilling tale of disaster and ruin. The severe earthquake that occurred on the night of May 9th, and the tidal wave that followed, brought destruction to many thriving towns along the coast of South America, and death to hundreds of their inhabitants. The earthquake seemed to result from the eruption of the volcano Ilaga, situated on the southern frontier of Peru and Bolivia. The first shock lasted from four to five minutes, and was succeeded by several others of less intensity. Then the sea, receding from the shore, seemed to concentrate its force for repeated attacks upon the land. At Arica the people were busily engaged in preparing temporary fortifications to repel a threatened assault of the rebel ram Huascar at the very moment when the roar of the earthquake was heard. The sea suddenly receded from the beach, and a wave from ten to fifteen feet in height rolled in upon the shore, carrying everything before it. Eight times this assault of the ocean was repeated. Strange as it may seem, only a few lives were lost at this place. At Iquique the wooden houses came tumbling down at the first shock, and a fire immediately spread among the ruins. The firemen, to procure water, had just stationed two engines on the beach, when a fearful cry arose—"The sea! the sea!" and the angry waves rushed in, and the engines were carried away. The inhabitants left the city to its fate, and fled to neighboring eminences. The earthquake, the fire, and the water, all combined, destroyed nearly the whole town, and also about 400,000 quintals of nitre stored in the vicinity. It is supposed that at least two hundred persons were killed at Chanavaya, where the shock was especially severe. Mexillones (or Mejillones) was visited by a tidal wave sixty-five feet high, and two-thirds of the

town completely obliterated. A mine about four miles from Tocopila sank in, killing about two hundred workmen. A wave thirty-five feet high swept along the principal business street of Cobija, an important town on the Bolivian coast, and left it as level as a desert. Eleven large vessels were totally lost, with many persons on board, and much other shipping seriously damaged. The property lost is estimated at twenty millions of dollars, and the loss of life on shore is supposed to be not less than six hundred."

The *South Pacific Times*, of Callao, Peru, says, to call the movement of the sea, which resulted in such a terrible loss of life, a tidal wave, is a misnomer, as a wave implies an undulatory motion, while the action of the sea in this instance was a series of distinct rotary upheavals, breaking into many cyclonic currents of great speed and power, and continuing for many hours. Later accounts from Valparaiso indicate that that port did not suffer much from the cataclysm, but the other Chilian ports did not escape damage, although not serious in comparison with that suffered in other places. Peru and Bolivia are the two countries that suffered most, the latter probably more than the former.

The movement of the sea is described as being very similar in all the ports along the coast from Callao to Coquimbo, Chili, although varying greatly in intensity. Pabellon de Pica is regarded as the center of the disturbance. At Callao the sea showed unusual agitation as early as 11 o'clock on the night of the 9th of May, and shortly after the bay was filled with gyratory currents, causing the ships at anchor to revolve about their chains as centers. The actions of the currents were strong enough to break away the stern moorings of large steamers. The sea showed several distinct upheavals, the highest one occurring about 4 a. m. on the 10th of May, the stone docks at that time being submerged. There were no disastrous results to the shipping in Callao harbor, but at the guano deposits considerable damage was done, and at one time the whole fleet was in danger of being cast ashore. The Governor of the guano deposit at Pabellon de Pica reported to the Peruvian Government that a powerful earthquake, extending all along the coast, commencing about 8:15 p. m. on the 9th of May, and lasting five or six minutes, caused the instantaneous outbreak of fire throughout the town, a fire which was in turn extinguished by the sea, which invaded the settlement six times, and shifting the position of the Government buildings, destroyed molls, boats, hydraulic machines and all the works connected with the loading of guano, and more or less damaged all the vessels at the deposit by collision or otherwise, sinking six. The loss of life at Pabellon was not fully ascertained, but 33 laborers are known to have been buried by a landslide. The Governor also states that there are 1,000 people without food and in danger of stavation.

At the nitrate deposits the works were thrown down by the earthquake, and those of Nueva Carolina, San Pedro, Matellana and La Barrencaber were ruined, involving a loss of 1,400,000 soles. Those at San Juan and Compania Taropoca were badly damaged. The entire loss at the nitrate

deposit, including supplies, can be set down at not less than 3,000,000 soles, more than double the loss experienced by the earthquake of 1868. The damage in the port of Constitucion, 120 miles to the southward of Valparaiso, was quite severe, several vessels being stranded and some of them totally destroyed. Ashore, the alarm was great, all the inhabitants flying to the hills, but up to the latest accounts there was no loss of life. Valparaiso seemed to enjoy a total exemption from loss. In Arequipa nothing more than a terrible fright was suffered. In Chanaral, Chili, about half past 8 P. M., on the 9th of May, a strong shock was felt, lasting for about three minutes. In the confusion a paraffine lamp upset in a house, and in a moment the edifice was in a blaze and the fire rapidly spread. While the greater part of the population was engaged trying to repress the conflagration, the sea was observed coming in, and it completed the destruction. The loss of life is confined to two persons, and two thieves were shot while detected in plundering. The damage to property will exceed $200,000. In Antofogasea forty or fifty houses were completely destroyed, seventeen launches thrown on the beach and three sunk with cargo. Mejillones is represented as totally destroyed, as were Cobija and Tocopilla. The store ship of the P. S. N. Co, has disappeared entirely, the family of the master of the hulk being on board at the time. In the vicinity of Chanavaya the loss of life was very heavy, nearly sixty men being killed by falling rocks that came down from the heights. The town of Chanavaya has completely disappeared, and large numbers were drowned, especially women and children. At Punta de Lobos considerable damage was done to the shipping, and nearly all of the buildings were destroyed. The unsheltered inhabitants are suffering untold miseries, and at the latest advices were on the verge of starvation. At Carrizoe Bajo, in Chili, the shock was very severe, and the steamer Luis Cousins was driven ashore many times, her hull suffering severely. At Pisco the damage to property and shipping was heavy, but no loss of life was experienced, although the houses in the town were nearly all destroyed. The *Times* gives a list of vessels totally destroyed, aggregating over fifty, and details of serious injuries to about seventy-five more. In addition to the disaster in Bolivia already reported by telegraph, all the people in one of the mines in Pera Blanca are known to have been smothered. The damage to Pabellon de Pica by the latest advices is summarized as follows: Over two hundred lives lost, five vessels sunk, twenty-seven so badly damaged as to be unable to leave the port. As nearly as can be ascertained the total loss of life in the visited district will aggregate fully 1,500, and the loss of property is enormous.

The San Francisco *Bulletin* says: "The more detailed statement of the late earthquake in Peru received from New York, gives the date of the occurrence as the 9th, but the compiler provokingly omitted the hour of the day. The first report of the convulsion, received by the roundabout way of London, gave the date as the 10th. But a calculation of the time at which the tidal wave which followed the earthquake manifested itself at

other points shows that this could not have been correct. The chances are that the telegraphic agent at London failed to notice that there were about four hours' time against him between Peru and his station. What was to him the 10th of May was the latter part of the 9th at the scene of the disturbance. Unfortunately, in no case is the exact period of time given at which the tidal wave appeared anywhere, so that no precise calculation can be made. But approximations are possible, which indicate that we may be on the eve of important scientific discoveries.

"Taking our date at 7:10 A. M. as a basis, we reach the following facts: The Sandwich Islands being 2,100 miles further westward are 2:20 ahead of us in time. At 4 A. M. the tidal wave manifested itself at Hilo. That would represent 6:30 A. M. at Anaheim. The time of the transmission of the wave to this coast would seem, therefore, to have been fifty minutes. Now, the time reported at Acapulco is 10 A. M. But Acapulco is about 1,500 miles more easterly than the coast of California. The difference in time will therefore be one hour and forty minutes—that is to say, Acapulco is, by that much, behind us. Four A. M. at Hilo would represent 8 A. M. at Acapulco, apparently allowing two hours for the transmission of the tidal wave between these points.

"The great fact here to be noted is that the tidal wave rolled upon the beach at Hilo fifty minutes before it was felt on the coast of California, and two hours before it inundated Acapulco. The height to which it attained at these points would seem to strengthen this view, for it was in greatest force at the place where it rose the highest. Waves lose force as they progress. Thus the tidal wave was twelve feet three inches high at Hilo, five feet at Anaheim, and three feet at Acapulco. But at the point of the original disturbance it was sixty-five feet high. This estimate is not extravagant when it is considered what it did, viz: it destroyed many towns, and lifted the United States steamer Wateree, stranded by the tidal wave of 1868, and carried her nearly two miles north of her old position.

"If we had the time of the tidal wave on the coast of Peru the calculation could be completed. But so far its dimensions are reported as follows: 65 feet at Mexillones, 12 feet 3 inches at the Sandwich Islands, 5 feet on the coast of California, 3 feet at Acapulco. Nothing has been heard of it south of Peru, but it is supposed to have been felt along the coast of Chili. It was noticed about the same time as the earthquake, or immediately thereafter. The first fact was a slight recession of the water, and then a return on the land with prodigious force, reaching the altitude stated. Then it flowed off, the power which it evoked propagating itself, apparently, northwesterly, to the Sandwich Islands, but retaining enough of force to rise 12 feet 3 inches there, then washing over on the coast of California 5 feet—coast of Mexico 3 feet. The action seems to be that of a sudden lurch of the earth in its rotary motion."

"The great tidal wave of May 9 and 10 on the Pacific," says the St Louis *Republican*, "is an interesting subject of study. It was evidently the

product of a great submarine upheaval, attended by a vibration of the earth over a vast area. The point of upheaval is thought to have been in latitude 22° west, and a short distance off the South American coast, about 5,500 miles south of San Francisco, and the time half-past 8 P. M. on the 9th of May. The wave traversed this distance in ten hours, reaching San Francisco about half-past 6 A. M. on the 10th, showing that it traveled at the rate of 550 miles an hour. It reached the coast of New South Wales, about 5,000 miles off, at 5:20 A. M. on the 11th, apparently a day later than it arrived at San Francisco; but as New South Wales is in longitude 150° east there is a day lost between the two places, and it is probable that an accurate calculation would show that its arrival in the two places was nearly simultaneous. Its most marked effect was on the Peruvian and Chilian, coast, where there was first a violent tremor of the earth and next an influx of the wave, which rose to the height of forty to fifty feet. At Valparaiso it exhibited itself at half-past 9 on the evening of the 9th, showing that the point of upheaval was about 550 miles north of that place. It is probable the whole Pacific Ocean shared in the disturbance."

The San Francisco *Chronicle* says: As yet the center of disturbance which produced the wave in the Pacific that destroyed Iquique on the 10th ult. is not ascertained. The direction from which it came may perhaps be determined by calculations from its time of reaching different places on the Peruvian, Californian and Sandwich Island coasts; and from the height to which it rose at different localities, especially on different sides of the Hawaiian group, where the variation of height was from 4 to 36 feet. Prof. Davison, of San Francisco, keeps a record of the height of the sea at that port by instrumental means, and he finds that the disturbance lasted for three and a half days after it began on the 10th ult., and that there was in particular a second shock ten or twelve hours after the first. About 2 or 3 a. m. on the 11th a shock of earthquake was felt in Perthshire, Scotland.

A correspondent of the *Christian Union* named S. Coan writes to that paper as follows: In February the whole kingdom of Hawaii was thrown into consternation by the eleventh and most remarkable of all Pele's eruptions,—Pele being the goddess of the volcano. In May a great tidal wave prolonged her agony. Of the latter, news has just come. Though the wave swept the shores of the entire group, it did the most damage at Hilo. Hilo, as the largest settlement on the island of Hawaii, always suffers the most on such occasions. On the 10th of May, at four o'clock in the morning, the waters of the bay began to rise and fall abnormally. At five o'clock they hurled themselves upon the shore to a distance of one hundred yards. In a moment the wharf, the warehouses, the shops, the native huts, the lumber piles, and a bridge that spanned a river tributary to the bay, were wiped out of existence.

The wide sand belt that girts the beautiful bay lies in a semi-circle.

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Bordering this is an embankment fringed with cocoanut trees; and here were the buildings that were swept away.

The long curve of sand beach terminates in a rocky pile covered with cocoanut trees and called Cocoanut Island. On this picturesque island stood the hospital. The island was completely submerged, and when it arose from the flood not a vestige of the hospital remained.

With the news of this tidal wave—not the first visitor of its kind—comes that of the unusual activity of the crater Kilauea.

Pele retreated into the bowels of the earth, making her next appearance beneath the waters of Kealakeakua Bay, not far from the spot where Captain Cook was killed.

This subterranean eruption opened a fissure under water a mile long and extending inland three miles. The little inter-island steamer "Kilauea" came upon the scene of action just in time to find a boiling sea lying directly across her path.

Boats and canoes pulled into the turbulent waters, which danced like rapids. Blocks of red-hot lava, some of them two feet square, rose constantly to the surface and bumped against the boats, but did no damage. Many smaller pieces of lava were fished out of the hot water and found to be so molten that the interior could be stirred with a stick. A part of the time the surface of the sea was covered with these hissing-hot lava blocks. As they cooled they sank. The specimens obtained were all porous and light—a kind of lava called by old natives *aa*—pronounced ah, ah. The fishes in the vicinity were killed. Rumbling noises and a severe earthquake shock accompanied the phenomena.

The waves rose to a height of from ten to sixteen feet, perpendicular, at intervals of not less than four minutes. A whaler lying at anchor in four fathoms of water grounded as the waves receded, and was whirled around with every ebb and flow. Although the Hawaiians are the most amphibious people in the world (I have seen a child that could not walk taught to swim), five of them were drowned. Boats picked up others who were swept from the shore and swam until assistance came."

# HYGIENE.

## HEAT AS A REMEDIAL AGENT IN DISEASE.

BY PROF. GEO. HALLEY, M. D.

The use of heat in one form or another in the treatment of diseased processes, is almost as old as the history of our race. And yet, with all the accumulated lore of this nineteenth century, we find men styling themselves scientists, scouting at the very idea of there being any remedial qualities in it.

In every advanced form of civilization in the past, we find one or other forms of heat used as a means to combat, or as an agent to cure ailments to which the human body is subject.

The history of the bath in the city of Damascus is contemporaneous with the history of the city itself. So, also, among the Greeks, Carthagenians and Egyptians. But not till Rome had donned the plume of Empire do we find anything like a well systematized form of the bath in use. The great and patriotic minds of the day, as well as the popular panderers to the desires and tastes of the people, so fully recognized their utility that they had public free baths erected for those who could not pay for them, even though the bath at that time only cost a small fraction of a cent. Thus demonstrating that in their far-seeing and patriotic policy, they recognized greater economy in preventing disease or checking it in its incipiency, than in curing it after it was fully established.

But not only as a remedial or preventive agency was it used, but as a luxury. They regarded it as a promoter of digestion, and so used it before meals to increase appetite, or even for purposes of gluttony and sensual indulgence, evidently showing they regarded it as a promoter of vital activity. It was on account of the licentiousness connected with the bath, or from the early Christians being excluded from them, that they almost entirely fell into disuse, after the fall of the Roman Empire—superstition in the name of Christianity taking the place of Pagan scientific Hygiene.

But among nations and tribes removed from that influence, we find it still used to a very large extent. Not only among nations with a history and a written language, but among barbarous tribes, such as inhabited this country. DeWolf, writing of the Mandin tribe of Indians, says, "When they became infected with small pox, they treated them with the hot bath, (hot air and hot vapor), with the effect of almost entirely stamping them out of existence as a tribe. But the fault is not in the agent, nor so much in the form in which it is used, but in not knowing when or how to properly use such a potent agent. It is indeed a "Damascus" blade, which in the skillful hand is powerful for good, while if used ignorantly, as it often is, becomes

all powerful for evil. But in this paper I shall confine myself to the effects of hot air, all steam and hot water baths being nothing more than lavatories.

Hot air then requires for its successful application, when used as a remedial agent, a complete knowledge of the process of life, and the wonderful part played in biology by heat.

We are in the habit of speaking of the Hydro-Carbons as the heat producing agents in the body, and I suppose if I should ask every member of this audience the question "What are the heat-producing agents in the process of life?" I would get for answer, "The Hydro-Carbons." But is this true? You all know this is an age of investigation and thought. Theories that at one time passed unchallenged are now closely examined, and if at fault, corrected or cast aside. Nothing in science is accepted on faith. Proof and demonstration are always called for. What then is the part played in this wonderful process that we call vital by the Hydro-Carbons, and why is the theory at fault that takes them to be heat-producing agents? The soft parts of the body may be divided into two great classes—one containing carbon, hydrogen and oxygen; and the other in addition to these, nitrogen and some other substances of less import. The first are known as the Hydro-Carbons, and last as the Nitrogenized elements of the tissues.

Of all the chemical elements known, none show such a persistency in cutting loose from their combinations. There is no compound that has nitrogen as one of its constituents that will for any considerable length of time resist the ordinary forces of nature that are productng disassimilation. The Hydro-Carbons will. The Nitrogenized compounds are always found performing more or less active vital functions, as for instance in muscles and albuminoids in the blood. The Hydro-Carbons, as tissues, are never found performing vital functions in any department of life.

We might go through the whole range of both animal and vegetable life, and we should only find them occupying a negative or passive position in either, while the nitrogenized are always the positive and active. The reason for this will be found in this very unstability. In order to have vital manifestations it is requisite that there should be a great celerity of movement possible among the atoms of which it is composed, or in other words, it should be mobile, for it is only in mobile compounds we find vital manifestations. But molecular change is only one of the factors in this wonderful process we call life, for not only is it necessary to have this change, but it must go on according to physiological law and also according to the special physiological law of the organism in which it is taking place both as to quantity and quality, as well as to the thermal and hygroscopic conditions. When the whole process comes to be investigated we find so many things imperfectly known or not known at all that we are at times tempted to despond of ever knowing the whole process completely. Some few things, however, we do know, and while investigating these we may be enabled to discover more. The changes that take place in the animal tissues in the process of life have to some extent been

investigated and some facts elicited. We know the change must be gradual, and while slow must at the same time be complete. It must be gradual in order that force may be produced in due amount, and at proper time. That time, in order to be normal must be at the bidding of the will, else we have a fit of epilepsy. It must be slow in order as much as possible to conserve tissue, prevent waste and relieve excretory organs of the great amount of excreta that would be cast on them for elimination.

Now, while we have been considering the changes that go on, the movements that take place among the elements of tissues, we must remember that Heat is duly one of the modes of motion, that those changes of form and combinations, arrangement and re-arrangements among those elements of tissue is only motion, and that motion is only a form of heat, in short, that Heat, Light, Electricity and Motion, if not demonstrably in every position and relation as the same, are so closely allied as to be, in most conditions, interchangeable, and that force—all forms of it with which we are acquainted—is but a manifestation of one of the forms of heat.

But we have shown that the nitrogen compounds are not only the most really changeable tissues but that it is those, and those only, that give vital manifestations, and that those vital manifestations are not only kept up and carried on by heat, but that they are themselves from the very nature of things the producers of heat. What purpose then is served by the Hydro-Carbons?

The terrible explosive compound known as nitro-glycerine is a fluid chemical compound of nitrogen. So also is the chloride of nitrogen, both having the consistency of oil. If nitro-glycerine is mixed with a substance that will separate its particles and at the same time destroy it as a fluid, it explodes it is true, but much more slowly though still with great force. It is on this plan the compound known as dynamite is made. If it is chemically united into a compound that is again mechanically mixed with other substances that still farther separate its particles though it is still explosive, it is much more slow, and if the mixture be capable of supporting combustion, as we find in gunpowder, we have more heat generated, for molecular change has been induced in the carbon, with which some of the gases now enter into new and simpler combinations. Now the vital process is carried on by the same means. But while the nitrogen compounds that give vital manifestations are in a fluid form they are very thoroughly mixed and chemically combined with other substances, notably the hydro-carbons. This would then appear to place them simply as dilutants, and sustainers of the combustion in vital process. It has long since been demonstrated that the heat producing process is not in the lungs but in the muscular and other nitrogenized tissues of the body. In intense febrile conditions it is not the fats or hydro-carbons that waste, but the muscles, blood and other nitrogen tissues. So well is the fact now determined that with a given fever heat the skilled physician can predict almost to an hour how long his patient will live. But each animal organism has its own

specific temperature. As for instance, the temperature of the human race is about 98.5°, while that of some birds is 109°, a temperature at which human life is only carried on for a few hours. But in those organisms where waste is so rapid repair is equally rapid, in other words, the organism is nicely adjusted to suit its own requirements. So that in a state of health the normal temperature never varies to any great extent. It is true the muscle during exertion manifests a marked rise of temperature, but as soon as the exertion is over it again sinks to or below its normal temperature. This is what is known as the stage of exhaustion. But the tissues of the body are not at once changed from well formed albumen, for example, into completely prepared excreta that are ready to be eliminated by the proper glands or structures, but they must go through a series of changes. each new compound that is formed being more simple than the one that precedes it, until finally it either passes out of the organism as a gas or some solid that is completely and perfectly soluble in water, and all those changes must be effected by the aid of heat, though they themselves are productive of heat. But we saw that the changes in the nitrogen compounds produced succeeding changes in the hydro-carbons, which being slow in taking on molecular change keeps it up, so that heat started in the nitrogen compounds is kept up or sustained and prolonged by the hydro-carbons.

We have stated that in order to a complete accomplishment of this process there must be a constant and equal heat. But if from any cause the initial stage of transformation is accomplished and too great an amount of heat is drawn off or lost, or there is not communicated to the hydro-carbons the stimulating force to produce necessary change in them, there secondary transformations do not take place, and we find the circulation loaded with partially or imperfectly transformed substances, which now become poisons to the assimilative process. Nature, now, in order to get rid of them has, as we say, to make an extra effort to cast them off, but in reality, those poisons produce their own cure. They, by their presence acting as irritants, set up an increased disassimilating process, which means an increased heat, hence we have fever. Now while nature is, by this increase of heat, putting those partially transformed materials that were floating in the blood in a proper form for excretion, she is burning up or disintegrating more healthy tissue, and the cause of the first stoppage or imperfect transformation of tissue not having been removed there is still the same necessity for increased heat to effect the the transformation process, all of which means greatly increased waste of tissue, and consequently of force. But this expenditure of force was not normal either from cause or for effect, for if it had been normal from cause it would have been done at the mandate of the will or in the ordinary performance of vital processes, and if for effect it is entirely out of its range of action. Hence, one of its physical manifestations is impairment of the intellect, or delirium, or in other words, an abnormal expenditure of force on and through nerve tissues. In thus following the biologi-

cal process, I think we have a complete explanation of the way in which heat acts in correcting morbid processes or "curing disease."

The high heat to the surface of the body—external and internal—accomplishes artificially what nature was trying to do from within alone, and that, too, without either the exorbitant waste of sound tissues of the body or increasing the quantity of imperfectly formed material in the blood, or in plain terms, a bushel of coal has done for the organism what the organism would have done by using up a large quantity of nitrogen of the body.

It may be replied to this that heat from without will produce the same amount of disassimilation as would have been caused by the fever process of nature. But experience shows this is not true. Tissues in a state of transformation in the blood are more powerfully acted on by heat than are the healthy tissues. For were this not so, the fever process would never be a curative, but always a poisoning and more rapidly destructive process than the one that set it up, a state of things every physician knows is not true. But heat applied to the surface promotes elimination by the relaxing effect it has on the skin and the sweating that is incident to the hot air baths. Friction, which should always accompany the bath, is another valuable aid in promoting circulation in the skin, and so exposing as much of the blood current as is possible to the action of the heat.

Having thus gone over in detail some of the reasons for using hot air as a remedial agent, we may conclude by summing up the whole matter.

Dry heat applied to the surface cures disease by hastening the necessary retrograde changes in the tissues that are already in a state of transformation, and fits them for elimination from the body, either through their own proper channels or by the sweating process carrying them out by the skin. It also hastens vital change in the healthy tissues, stimulates the gland structures and so aids in clearing the whole blood current. But it is not a cure-all, even though it does all this. To point out and enumerate all the diseases and diseased conditions in which it may be used with benefit would, in the present paper, be out of place. But in general terms I may indicate its range of usefulness as well as warn against its harmfulness, for, like all good and powerful agents, it is powerful for harm as well. The secret of obtaining good from its use lies in knowing *when* and *how* to use it.

All diseased conditions that owe their existence to imperfect assimilative or disassimilative processes, without organic structural change, will be benefited by a judicious and intelligent application of the hot air bath. But, on the other hand, there is a large class of diseases that are caused by structural alteration of glands, either accidental or otherwise; or there is another class that depend upon some form of ferment, poison, or living organisms, introduced from without, and when once within the blood current produce the most baleful effects. These the hot air will but slightly benefit, do no good to, or will act as a direct injury, appearing to hasten the process of disintegration that already is going on much too rapidly.

I have thus trespassed on your time from knowing the ignorance that

exists on this subject, both among professional therapeutists and the masses of the people, and shall feel myself amply repaid if I have set people thinking in an intelligent way about this great and all powerful agent—Heat.

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## DENTAL PATHOLOGY.

BY A. H. TREGO, D. D. S.

Dr. Parmele, in the April number of the REVIEW, says: "The most frequent cause of the death of the dental pulp (nerve) is from medicaments applied by the dentist."

It must be admitted that procrastination on the part of the patient is the primary cause; after which the injudicious use of medicaments completes the "slaughter of the innocents." Another frequent cause is the unskilful use of instruments; as also packing the filling in immediate contact with the exposed, or partly exposed pulp.

Thorough knowledge of the anatomical and chemical structure of the teeth, with judgment as regards age, development, and other variable circumstances, are absolutely necessary toward constituting a "competent dentist."

All operators, however, are liable to expose *the point* of a pulp in excating cavities of any considerable size or to meet with extremely sensitive dentine immediately over the pulp. It is either of these cases that Dr Parmele alludes to. The remedy he leaves the ordinary reader and uneducated dentist to guess. Great care is necessary to avoid these sensitive points until the other parts of the cavity have been cleansed, after which mild narcotics or styptics should be used to allay inflammation. If, now, the dentine is sufficiently healthy and the pulp but little exposed, a safe operation may be effected by "capping" and filling.

The "fatal cases" are produced by the ignorant and indiscriminate use of cauterants, alkalies or acids "to obtund pain." Any one at all acquainted with therepeutics and chemistry ought to know that chemicals of that character will devitalize and destroy anything like flesh and blood with which they come in immediate contact. Hence the correctness of Dr. Parmele's assertion. However, arsenic, creasote, carbolic acid, iodine, chloride and oxychloride of zinc, etc., etc., are indispensable in a well regulated dental office; but, one application of any one of them to an exposed dental pulp renders extirpation absolutely necessary to the health of the tooth and comfort of the patient. I know there are operators who oppose this theory, who assert and believe that "when the nerve is destroyed the tooth necessarily becomes discolored and dies."

These same operators "obtund pain" (?) by use of the aforesaid chemicals, and the last thing before filling they cover the partly decomposed pulp with cotton saturated with creasote "to prevent the tooth from aching." If they have any knowledge of anatomy, what would they think of a surgeon who would attempt to hermetically seal such a powerfully decomposing

agent in any other part of the human organism? Would he not be guilty of malpractice?

Aside from theory, practice proves that in a large majority of cases where pulps are "treated" and left in intense suffering and alveolar abscess is the inevitable result.

It is an established scientific fact, that a tooth not otherwise injured receives all necessary nourishment and vitality from the peridontium after the pulp has been extirpated and the channel properly filled. Also, that after ulceration and alveolar abscess have occurred, the surrounding parts may be restored, and the tooth rendered permanently healthy and useful.

After years of experiment and comparing notes, the leading authorities of the profession are unanimous as regards the modus operandi of devitalizing and extirpating dental pulps; as also of the necessity of filling the cavity with some substance that will render it absolutely impervious to moisture or gas, either by percolation or imbibition from the surroundings.

To devitalize a pulp: First, excavate the superficial decay and foreign substance usually found in decayed teeth, dry the cavity and apply "nerve paste," (arsenic and creasote), immediately on the pulp, by means of a small tuft of floss, cover this with cotton saturated with Sandarac varnish. Be sure to exclude all air and moisture, and not get any of the paste on the gums or lips.

Never apply arsenic while peridontitis exists. Leave the nerve paste in from ten to forty-eight hours, as circumstances demand; then remove it and cut away as much superfluous dentine as the condition of the pulp admits. Now apply creasote for from three to ten days, usually five to seven days; exclude moisture and air as before. Fungous growth of pulp may be treated similarly. As little arsenic and creasote as possible should come in contact with the bony structure of the tooth, as they will soon destroy it.

Arsenic "devitalizes," creasote "tans," or causes the pulp to "slough."

I prefer carbolic acid and iodine for fungus, abscess and necrosis, but use it sparingly in contact with the dentine, as it is liable to discolor the tooth by continued use. Never use cauterants in the cavity after the pulp is removed, except for abscess, necrosis, etc.

When the pulp has been made insensible it can be readily extirpated. Remove all of the pulp—to the apex of the fang, have the cavity thoroughly cleansed and free from inflammation, and as a final dressing before filling the fang, wash it out with a tuft of floss saturated with equal parts of tincture of belladona and aconite root. Tepid water, by means of a syringe, should be freely used in cleansing all cavities.

Until a few years ago the leading dentists considered gold the only proper material with which to fill "pulp canals." They roll a cone to supposed size, having it semi-solidified, and then guess how far to drive it in. Having everything in readiness, they dip the cone in creosote and insert it. If periostitis or abscess follows they attribute it to "exostosis," or to the patient "taking cold." A majority of cases treated in this way result

unfavorably; first, because creosote is certain to produce decomposition, which is certain to find the easiest way out—through the alveolar.

Secondly, because it is a mechanical impossibility, in a majority of cases, to fill pulp canals perfectly with gold or any similar material.

Similar or worse failures occur with operators who use oxy-chloride of zinc, or similar cements. Many use the zinc for capping exposed pulps. If they will carefully observe they will see that the acid will disintegrate and destroy membrane, fleshy fibre, dentine, etc. Used as a capping decomposition of the pulp with all the attending evils, is as sure to follow as sparks to fly upward. As a filling for roots I have no faith in any of these "concretes," from the simple fact that in thousands of cases that have come under my observation, I have never seen a pulp canal made perfectly impervious by their use.

In a series of expertments in connection with a proficient chemist, I was incidentally led to try a compound of paraffine and caoutchouc for filling pulp cavities. Being readily applicable, and so superior to any metals or pastes then in use, it was presented to the Dental Colleges and Societies and pronounced perfect.

In 1866 I adopted the use of a compound of paraffine, gutta percha and feldspar—equal quantities. This preparation, when cool, is sufficiently hard for temporary fillings in surface cavities; is as easily worked as wax, and is perfectly insoluble, except by chloroform, ether and naphtha. Being applied in a semi-plastic condition, it fills every portion of the canal readily, and forms a cement that renders the walls perfectly impervious to moisture or gas.

I have used one or the other of these compounds for twenty years, and never failed to permanently preserve all teeth that I previously diagnosed susceptible of being restored.

After thoroughly testing this preparation and modus operandi, several proficient members of the profession have adopted the motto: "Never extract a tooth while there is a root to build a top to, or a top to build a root to."

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## HINTS FOR SUMMER BATHING.

Dr. W. H. Vail, M. D., well known as one of our best medical writers, gives the following sensible suggestions on this subject in the *Christian Union:*

As summer approaches, rules for bathing are apropos. Whether in bath-tub, river or ocean, bathing should be accompanied only by pleasurable sensations. The whole body should be kept aglow. If any shiverings or chilly sensations are experienced, either you are not well, the water is not of the right temperature, or you are bathing too long. At all events, such feelings are nature's warning that you should at once leave the water and give yourself a thorough rubbing with a coarse towel. Bathing, especially swimming, necessitates great muscular activity, therefore in order that diges-

tion may not be interfered with, at least one hour, and better still two or three, should elapse between a hearty meal and bathing. It is easily seen that eleven in the forenoon, four in the afternoon, and just before retiring at night are the best times for bathing.

Some like a cold dash on rising in the morning. Very few, comparatively, can stand such a shock to their nervous system. Let those who enjoy it, and experience a glow during the operation, continue the practice; but let them be careful how they urge its adoption upon those whose nerves possess a less degree of resistance.

Any one desiring to acquire the habit of a cold bath every morning should begin the custom in the warm weather, continuing it during the winter, and not commence it in the latter season.

If you are perspiring from walking, rowing or other exercise, as you reach the place of bathing do not (as some advise) sit down on the bank to cool off before entering the water. Doff your clothes and dash in as soon as possible, only being careful to keep up the exercise without intermission after you are in the water. In this way you continue the glow which you experienced from the previous exercise.

Ten, or at longest fifteen, minutes in the water should suffice for the strongest aqueously inclined urchin. Strive always to leave the water before you feel chilly, or certainly at the first approach of any such sensation, and continue or rekindle the glow by a vigorous rubbing with a coarse towel.

Turkish superstition says wet your head thoroughly upon entering the bath; we say do it to prevent rush of blood to the brain, which event may cause death.

Finally, as bathing, apparently a simple process, is not without its dangers, we would warn all boys not to begin the practice too early in the season, or to repeat it too often daily. Many have found an early grave by over indulgence, while others have endured long years of suffering from the obscure effects of excessive bathing. No physician should consider it below his calling to give specific directions to all seeking his advice as to when and how long they should bathe.

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## COOL ADVICE.

It is quite worth while to mention the two or three preventives of great heat, especially at night, which in tropical climates Europeans have been taught by long and varied experience to adopt, and which only seem absurd to Englishmen at home from ignorance of the whole subject. The first and foremost of these is to keep quietly at home out of the sun and its temporarily injurious light. Englishmen in the West or East Indies, or in China, would be considered simply crazy if they walked about with the thermometer marking 100° in the sun, with their necks unprotected, as Londoners have been doing all this week. Experienced residents would tell them that no change of dress, no attention to diet, no carefulness about

cleanliness, will give them half the serenity and comfort they will obtain from stopping at home; that when the thermometer ranges above 80° in the shade, the impact of the sun's rays is positively and directly injurious to the constitution, producing physical deteriorations which may affect them for life. Not only are the effects of a sunstroke permanent, and liable to reappear on hot days even in cold climates, but the effects of exposure to the sun, though not producing sunstroke, are often recognizable for years, producing, among other well-ascertained consequences, a distinctly separate liability to be affected by any form of alcohol—the key, we believe, to the extraordinary mischief drink works among the southern races, and the key also, most fortunately for them, of their instinctive aversion to liquor. It is not the heat, but the light of the sun, which produces these consequences, for a good umbrella prevents them; and the man who must be abroad in the light of days like last Tuesday should carry one as carefully as he does when he is only afraid of spoiling his hat. Two seconds will sometimes do the mischief, and he had much better bear being told that he is careful of a bad complexion than incur a permanent liability to suffer whenever he takes a glass with a friend. Next to keeping quiet, and as much out of the glare as possible, is the use of cool water in profusion, and that not only to drink, though water drinking is probably beneficial. Nature makes very few blunders, and the dislike of repeated draughts of water, which is shared, we believe, even by some physicians, is as irrational as would be a dislike of stokers to put on fuel where fire is needed. All the tropical races in summer drink hard of water—even the Bengalese, who, by pouring it straight into their throats, lose all its pleasant coolness in the mouth. The New York *Times*, we see, objects to iced-water. but the New York *Times* is only laughing at the teetotalers through a *bizarre* use of their alarmist phraseology. Water iced till it trembles on the verge of solidification, and taken after a full meal, may injure some weak stomachs; but water iced till it has the temperature of a cool spring will hurt nobody at any time or in any quantity whatever that an ordinary appetite is likely to crave. One would think, to hear some people talk, that thirst was in itself a good, instead of a symptom of exhaustion. But water has other qualities than the allaying of thirst. It has a permanent determination to evaporate, which nature obeys, and, as it cannot evaporate without heat, it positively diminishes in the process the heat of our rooms. Pans of water, the cooler the better, stationed about a bedroom will positively reduce, not the sensation of heat, but the heat itself. Let anybody who doubts that have his tub, with its shallow depth and wide surface, filled with spring-water, or water with a good block of ice in it, and placed in his bedroom, and mark in half an hour how many degrees the thermometer has fallen. It ought to be 6° at least, and will be 8° if he is not stingy with his ice, and the improvement, equivalent in comfort to a fire on a winter's night, will last for hours. If that is still insufficient, let him throw up his bedroom windows, fasten an old blanket or traveling-rug across the

space, and drench that well with water, and in five minutes the air in the room will be reduced to that water's temperature. Never mind about breeze. The air will seek the cooler place itself, without being driven in from the outside, and the temperature will decline almost instantaneously to a reasonable point. Not one of these expedients necessitates any change of habits, or any expense whatever, though of course a shilling or two laid out for ice will make the improvement more rapid, and in the case of a sick room, or of any one who really suffers from heat—suffers as if in sickness, we mean—will be money will laid out. And so in the case of little children, especially, will a few shillings on the sheet of woven cane—we have unfortunately forgotten the trade name—which is used in the hottest corners of the East Indies and China for pillow-cases and sofa-covers. The silica with which this material is coated will not get warm, and every other covering for beds or pillows with which we are acquainted will. It keeps perfectly dry, cannot get dirty, and can be procured as soft as any covering that ever was placed upon a mattress. There is hardly any luxury like it in intense and stifling heat, and we have known sick people, half maddened with heat acting on exhausted frames, sleep on it when sleep seemed otherwise unprocurable. With plenty of wholesome water, wetted blankets for window-curtains, and a sheet of cane, no one in London ought to be rendered sleepless by heat, or indeed, unless he presists in gorging himself with the food which he needs only in cold weather, to suffer any appreciable discomfort. —*Spectator.—Popular Science Monthly Supplement.*

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## SUNSTROKE AND ITS TREATMENT.

The sudden accession of heat has already produced one fatal, and more than one severe, case of sunstroke in the metropolis. Probably the affection so designated is not the malady to which the term *coup de soleil* can be properly applied. The condition brought about is an exaggerated form of the disturbance occasioned by entering too suddenly the "hot" room of a Turkish bath. The skin does not immediately perform its function as an evaporating and therefore cooling surface, and an acute febrile state of the organism is established, with a disturbed balance of circulation, and more or less cerebral irritation as a prominent feature of the complaint. Death may suddenly occur at the outset of the complaint, as it has happened in a Turkish bath, where the subject labors under some predisposition to apoplexy, or has a weak or diseased heart. It should suffice to point out the danger and to explain, by way of warning, that although the degree of heat registered by the thermometer, or the power of the sun's rays, do not seem to suggest especial caution, all sudden changes from a low to a high temperature are attended with danger to weak organisms. The avoidance of undue exercise—for example, persistent trotting or cantering up and down the Row—is an obvious precaution on days marked by

a relatively, if not absolutely, high temperature. We direct attention to to this matter because it is obvious the peculiar peril of overheating the body by exertion on the first burst of fine weather is not generally realized. It is forgotten that the increased temperature must be measured by the elevation which has recently taken place, not the number of degrees heat at present recorded. The registered temperature may be more or less than that which occurred a year ago; qut its immediate effects on the organism will be determined by the conditions which have precede it and violence of the change.—*London Lancet.*

As the heated term approaches, the rules for the prevention and treatment of sunstroke gain new interest. The Board of Health has collected some information upon this subject in the form of a circular. Copies have been printed in English and German, and are to be circulated through the city very soon, especially among the laboring classes. The following is the principal part of the report:

Sunstroke is caused by excessive heat, and especially if the weather is "muggy." It is is more apt to occur on the second, third and fourth days of the heated term, than on the first. Loss of sleep, worry, excitement, close sleeping rooms, debility, abuse of stimulants predispose to it. It is more apt to attack those working in the sun, and especially between the hours of 11 o'clock in the forenoon and 4 o'clock in the afternoon. On hot days wear thin clothing. Have as cool sleeping rooms as possible. Avoid loss of sleep and all unnecessary fatigue. If working indoors and where there is artificial heat—laundries, etc.—see that the room is well ventilated.

If working in the sun, wear a light hat (not black, as it absorbs the heat), straw, etc., and put inside of it on the head a wet cloth or a large green leaf; frequently lift the hat from the head and see that the cloth is wet. Do not check perspiration, but drink what water you need to keep it up, as perspiration prevent the body from being overheated. Have, whenever possible, an additional shade, as a thin umbrella, when walking, a canvas or board cover when working in the sun. When much fatigued do not go to work, especially after 11 o'clock in the morning on very hot days if the work is in the sun. If a feeling of fatigue, dizziness, headache or exhaustion occurs, cease work immediately, lie down in a shady and cool place; apply cool cloths to and pour cold water over head and neck. If any one is overcome by heat send immediately for the nearest good physician. While waiting for the physician give the person cool drinks of water or cold black tea, or coffee, if able to swallow. If the skin is hot and dry, sponge with or pour cold water over the body and limbs, and apply to the head pounded ice wrapped in a towel or other cloth. If there is no ice at hand keep a cool cloth on the head, and pour cold water on it as on the body. If the person is pale, very faint and pulse feeble, let him inhale ammonia for a few seconds, or give him a teaspoonful of aromatic spirits of ammonia in two tablespoonfuls of water with a little sugar.—*New York Tribune.*

## THE FEEDING OF INFANTS.

Dr. W. Faussett, in an interesting article on this subject in the *London Medical Press and Circular*, arrives at the following conclusions:

*First*—That aliment should always be presented to the infant stomach in a perfectly fluid form.

*Second*—That as bread and farinaceous substances generally have been proved by experience, and recently by numerous post-mortem examinations, to be often indigestible, and to have led directly to infant mortality, such substances had better be excluded from infant feeding.

*Third*—That cow's or goat's milk, when pure and modified as much as possible to resemble human milk, will often be found sufficient, without any other help, to nourish the new-born infant.

*Fourth*—That as cocoa contains all the elements indispensable for the growth and development of the body, and can always be presented in a fluid form, it is, next to milk, preferable to all other natural substances as an article for infant aliment.

There is one other point, which, though only indirectly connected with infant feeding, is one of paramount importance, as regards the present and future health of the individual, namely, the necessity of guarding against the hateful practice of covering the child's face as it sleeps.

The mistaken kindness and over-zealous attention of nurses in excluding the pure air of heaven from entering the lungs, in order to guard against the effects of cold, will often be exhibited in the soft, pale flabby condition of the infant's body, while a cachectic condition of the blood will be insidiously generated, which must prevent the infant thriving for the present, and possibly may lay the foundation of tubercular and other diseases in after-life.

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# POPULAR EDUCATION.

## SCIENCE TEACHING.

BY PROF. E. C. CROSBY.

[Read at State Teachers' Association, June 28, 1877, Sedalia, Mo.]

I propose to state the correct method of teaching science, some of the errors of our common methods, and some thoughts upon the intellectual and moral results of such teaching. An English philosopher has defined the word "science" as a correct interpretation of natural objects and their phenomena; a comprehension of law wherever law prevails. It will be assumed that the senses are the pioneers of all knowledge, and that whatever is learned as absolutely new must be comprehended by the plan of Froebel.

XUM

With lemon in hand the teacher stands before his inexperienced pupil; biting it, he says "It is sour," and the statement is repeated by his pupil. After pressing the lemon the teacher says it is elastic, repeated by the pupil. Now, stating the language of the teacher, he says, "The lemon is sour and elastic." What has the pupil done? Pronounced two words and has seen method. What more has he been taught? Nothing. The pupil must taste and press the lemon, or, from it, he can never know these properties. This knowledge is absolutely experimental; the meaning of these two words can never be communicated. In this case the teacher's faculties of perception have been improved, and his stock of knowledge increased. The pupil has vocalized two words having no meaning—has been crammed.

A pupil secures a bladder to the receiver of the air pamp. Taking the handle he experiences the effort that moves the piston, withdraws the air until he hears the roar and feels the blow of the shivered membrane. Now the text book is consulted, ideas are generalized and the understanding enlarged. Thorough, definite, exact and unmistakable is his knowledge. Now he rises in class to recite a living knowledge gained from a personal investigation of the subject, and not what he is able to reproduce from memory of what some one has said about atmospheric pressure. It is ever true that the nearer the person is brought, by the use of his senses, to the phenomena which he wishes to know, the more rapidly does he cultivate his faculties, acquire method and obtain knowledge. In all education the idea should precede the technical term which designates the object. As the definition is the result of certain physical processes, it must ever succeed a knowledge of the object and not precede it. A western school report contains a recommendation to the school board to place a complete set of weights and measures in the primary departments—these should be in every school in the state. Burke long ago said what every practical teacher knows, "I am convinced that that method of instruction which most nearly approaches methods of investigation is the true method." How does such a knowledge and discipline compare with the weak, pallid and hollow words recited by the pupil who has only seen the text book! Incomprehensible as may be the association of the intellect and the brain, there is no doubt, that, to the extent that this organism is affected by the sensation of the different senses, does knowledge become more tangible, objective, definite and real. While dissecting a shark and puzzling over an unknown organ, I asked Prof. Agassiz its name. "First find out all that you can about it, then I will tell you," he answered. Who does not see the method and philosophy of teaching in this remark? At another time he said: "I hope you have brought no books, for I don't want you to read." "When we study books we are prone to remove away from the things we study." "You must consider things unknown to you as unknown to science." With regard to physical science Prof. Huxley says that mere text book work is a sham and a delusion, while Guiot has added the warning that "The bane of our school work is the confounding of knowledge with memorization." It

was Bacon who advanced and stoutly defended the view that science teaching in our schools should be made intuitional, living and practical.

The pupil commences mechanics. He has studied no books upon the subject. He places the load at one end of his lever—a bar of iron, or a piece of board—near which is the support or fulcrum, and his hand pressing downward at the other end; he removes the support now toward the power and now toward the load, measuring the distances, performing calculations and determining results—knowledge in its true and only sense is acquired. No more interesting sight can be witnessed than a class of young ladies and gentlemen exercising the mental powers. By more exact methods they now proceed to ascertain the well known law of the lever. How? Not by such mystical conceptions advanced by Aristotle, that such a motion of the lever is in accordance with nature, and such a motion is contrary to nature, but by the method of Archimedes who first gave us the law—by absolute experiment. Let us note that in the study of the lever the senses of the pupils, the faculties of mind have been exercised and disciplined by bringing them into direct contact with the objects of knowledge, instead of what some one says about them. The observer's powers have been employed, the habit of attention gained and the necessity of exactness felt. He has applied his power of comparison, generalizations have followed and the understanding has been enlarged. He has seen the problem and felt the obstacles, and strengthened by the conquest and cheered by his successes, he is fresh for another subject.

Now to the teacher's work. What has he done? Exhibited the experiments to his class? No. Exercised his own faculties instead of his pupils? No. Has he imparted any information? No. Crammed his pupils? No. Then what has he done? He has most marvellously kept his mouth shut. I am daily more convinced that the work of the teacher is, primarily, not to impart knowledge but to abstain from imparting knowledge. Stated differently, successful teaching is that kind of direction which enables the pupil to acquire for himself. But life is short, says one, and the much in the little which it is possible to learn, requires time. Shall the pupil be abandoned to aimless and uncertain trial, to the fate of fortune, to the haphazard successes of the laboratory for the acquisition of knowledge? Kepler wrought thirty years, successively testing nineteen different hypotheses, before he discovered the form of the planetary orbits, while the world has been many thousand years in learning the nature of combustion. It is here that the directing power of the teacher avails in placing the pupil in the way that he may acquire for himself.

I am satisfied that the most of the work of pupils should consist of an exercise of faculties, instead of memorizing the finished knowledge of those who have obtained it by such exercise; that one of the principal aims should be the acquisition of method; that these mental processes should be concentrated upon the objects which alone develop them; that a knowledge of the object should precede a knowledge of its name; that a knowledge of the

thing defined should precede the definition; that a knowledge of the relation of facts should antedate their form of presentation; and that conceptions, standing out in clear relief, should precede an opinion. Not long hence will our text books be founded upon the fact that education is the development of faculties by use, rather than upon the theory that the mind is an elastic receptacle that will indefinitely expand according to the quantity of finished knowledge poured into it. The best that instruction can afford, and the aim with which it should be given, is, first of all, to cultivate the powers of observation, analysis, comparison and judgment; second, method of investigation; third, knowledge. Such a course of teaching impels the student to examine an object before him, instead of what some authority says about it; to consult his own good sense and experience, and to rely upon his powers —the same powers which he will daily use through life—instead of consigning them to the purleius fear and distrust.

Knowledge! knowledge! is the cry upon all hands, and teachers everywhere are more diligent in imparting it than in developing the "muscle and brain" with which the pupil may acquire it for himself. So wild and great is the rush for knowledge, that we have overlooked the psychological conditions of its acquirement, and now find ourselves buried in the exclusive study of books and drawing pictures, dignifying the work by such expressions as "teaching botany," "teaching zoology." The great want of educational system is method and not knowledge. The old adage that "knowledge is power" has rightly been called false, for it is perfectly true that only so much of knowledge, that has been gained by the natural processes of acquisition, involving the use of faculties, is power. Teaching for the sake of knowledge is the work of the crammer, and it is too common that solid acquirements are measured, not by the capacity to comprehend, apply, and originate, but to recite by the yard. Cram has been very aptly defined by an English lexicographer, as a species of intellectual feeding which is neither preceded by appetite nor followed by digestion. The work of the boy who wrote upon the board, "Bacon wrote the 'Novum organum' and the 'Instrationara Magna,'" is daily equaled at the cramming feasts where are served up such dishes as abridgement, appositive, future perfect, auxiliary, recurrence, definitive, trochaic, intransitive and subsequent. The time is fast approaching when the common school will teach the use of the English language, leaving its technical details and abstract philosophy to the maturer minds in the higher schools of the States.

In support of the above views, let me read from the pen of Dr. Whewell, "The most obvious method of affecting this discipline of mind * * * is the exact and solid study of some portion of inductive knowledge as botany, geology, comparative anatomy and chemistry. But I say the exact and solid knowledge; not a mere verbal knowledge, but a knowledge that is real in its character though it may be elementary and limited in its extent. The knowledge of which I speak must be a knowledge of things and not merely the names of things; an acquaintance with the operations and productions

of nature * * * and not merely what has been said about them; a knowledge of the laws of nature seen in special experiments and observed before they were conceived in general terms * * * by such study of one or more departments of inductive knowledge the mind may escape from the thralldom and illusion which reigns in the world of mere words."

What then should form the basis and material of an educational system? "Utility," "the demands of the Age," "The claims of the Past," "The wants of the Future," have each been proposed. It is not a little interesting to trace the growth of the view that the nature of the mind itself should form such a basis, in the champion efforts of Comenius, Bacon, Rousseau, Schopenhauer, Lankoster and Rosenkranz, down to our own Pestalozzi and Froebel. It should be remembered that our theories of education and the science of education are not necessarily synonymous terms. To this fact theories must give room—the essential character of all knowledge is experiential. The strength of this position is in part illustrated by the fact that he who has never experienced bitterness, transparency or an electric shock, for instance, can never receive from others more than their empty names. This knowledge is absolutely incommunicable, and it is thus with all knowledge, which an analysis of the character of knowledge abundantly proves. We may point the way by which the pupil may acquire it, but to communicate new truth is utterly impossible. "How then," says one, "are we able to tell a person what he did not know?" We can not. He who is able to understand or receive the proffered information must do so by marshaling his past psychical experiences in the order mentioned by the informant. Should it contain a single item or element that has not been experiential with the learner, he is in the fog, and, no matter how great his anxiety, utterly incapacitated to accept (understand) it. More important than all other facts and stranger than any fiction does the bearing of this truth have upon our educational system. The illustration and proof of this position would lead us to consider the nature, office and certainty of symbolic knowledge, which our time will not allow, but it may be satisfactorily wrought out by each individual teacher. Our conclusion, then, is that the advancing knowledge of the pupil depends wholly upon psychological experiences, and these in turn result only from physiological ones. Beside the deep, sate and buoyant sea of presentation we lie stranded, half wrecked upon the shoals of a so-called representative knowledge.

If science teaching should be made practical, where is the time for the work? The time when a man can compass the whole field of human knowledge is past, for there is scarcely a single department of study that can be mastered by one individual. In the language of a great man (Ag.), "We must be contented to know *little*, but to know that little well." However, when we shall have lopped off that great mass of useless stuff, the acquirement of which neither brings discipline nor intelligence, we shall have time to accomplish much. The most of our mental arithmetic drill might very sensibly step down and out to make room for the elements of

botany and zoology, while circulating dec. Permutation, annuities, duodecimals, principles of L. C. M. & G. C. D., progression, the extraction of the fifteenth root, arbitration and the endless details of geology and grammar, plunder the time which rightfully belongs to physiology, natural philosophy and chemistry.

Every performance of duty, every calculation, every forecasting of probabilities, and every act of life, is performed by the judgment and not by the memory. Science most completely prepares one for this work. Many branches, now excessively taught, do not afford a field for the free exercise of judgment, and largely such is the character of the classics, history and the mathematics. These present inviting range on the sole condition that the pupil admits certain facts, definitions and axioms, and from these, not losing sight of them for a moment, "he advances in the groove of thought," which has been so unkindly marked out for him. It is noticeable that the problems in arithmetic contain only those factors necessary to a solution. To a certain extent he loses his personality, while his individuality is not only hemmed in by boundary walls but is finally swallowed up by the authority of the teacher, and the well picketed gulf of the lexicon. In life, the facts with which he deals have been classified by no kindly hand, and among these diverse interests, conflicting elements, the strange objects and the stranger phenomena, he stands perplexed, confused, and well nigh powerless. Each person commands the art of reasoning to the extent that he has not learned its formulæ, varieties and rules, but practiced them (whether or not they have been definitely formulated). The formation of judgments and the processes of reasoning are practiced by the race, inexactly by the many, tolerably by some, and correctly by a few. Science appeals to individual reason and individual responsibility; its truths are determined by no authority but nature herself; it furnishes a knowledge of what is and, to a limited extent, what is not; it teaches us to distinguish what is known and what is probable, and to know facts as distinguished from their various interpretations. Dr. Porter says that in the education of the judgment science has no equal. How many problems in life there are, whose solution depending only upon judgment, awaits a master mind—corporal and capital punishment, suffrage, legislation, recreative amusements, Sunday laws, rights of citizenship, capital and labor, prison discipline, currency, intemperance, taxation and Prof. Tice. Only the most thorough culture of the mental powers, by use, can enable the race to cope with the ever-increasing demand of civilization, even in a tolerable manner. Witness, too, the one hundred "isms" that press their claims for man's recognition. One demands a faith which rests upon certain phenomena, while the phenomena allow examination only on conditions that forbid acceptance; another, a belief in the invariability of the so-called natural laws whose universality investigation has rendered only probable; another, an uncritical faith in authenticated history, whether it accords with or contravenes the use of good sense.

The present age demands what the past did not require, and it is proba-

ble that the future will not be satisfied with that which satisfies us. Educational requirements change and systems grow. It has not been long (1771) since the University of Salamanca refused the admission of physical science on the ground that Newton taught nothing that would make a good logician or metaphysician, and, "as for Gassende and DesCartes, they do not so well agree with revealed truth as Aristotle does." The present age demands that both science teaching and scientific teaching shall permeate the whole educational system, not for its discipline alone, but for its other results. He who believes that they should become something more than mere "optional" studies upon the ground of mere utility, assumes a not impregnable situation, but, if it can be shown that, while it serves the purpose of use, it embraces a thorough discipline of the faculties and contributes to intelligence, it has my support.

The new fields of inquiry, of striking and exhaustless interest opened up by scientific researches, astonish by their number, gratify by their freshness, and captivate by their singular attractions. Thanks to the balance of Coulomb, the achromatic of Dollond, the micrometer of Gascoyne, the dividing engine of Rameden and the chronometer of Harrison, the world has extended its field of research into the realms of matter and meditation 300,000 to 400,000 times as far as was known to Middle Age life and the old Chaldeans. The millionth of an inch in space and the millionth of a second in time are noted with accuracy. Davy said that nothing so much tends to the advancement of knowledge as the application of a new instrument, while the historian of science (Whewell), refers every great intellectual advance in education to the effect of some scientific discovery. Is it not very probable that the acquisition of these new fields are preceded by close application? And is it not probable that occupation in these fields of inquiry should not result most favorably to the mental capital of the state and country? I will not mention the departments of science—it embraces life.

One of the principal advantages resulting from the scientific pursuit of science, is the ability to suspend judgment or to reserve it, until an examination of the case has been made. Hourly is the student of science compelled to practice the advice of Jacotot to his pupils at Louvain. "In all your learning do homage to the authority of facts." How easy in life it is to see those facts which favor our views of any subject, and how conscientiously do we fail to see the application or parallelarity of those which oppose them. Multitudes—not all of them outside of our profession—are ever ready to pass judgment and draw conclusions at first sight, in a very dogmatic manner, neither thinking of the necessity of an investigation, nor knowing even the laws of an examination. They neither realize the unreliability of testimony, the urgency of timely precaution nor the nature of evidence. Who does not see the profound abyss between the knowledge that an examination should be made and the ability to make that examination; between the knowledge that precautions and allowances must not be overlooked, and the untrained ability to act with prudence and allow with safety;

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between the knowledge that all factors must be collected and classified, and the ability to collect and classify them. In the light of these facts science studies again appeal to us for a change of venue from the "optional" to the "required" course in the curriculum of education. Reservation of judgment is almost unknown, and he who practices it is considered mulish and intolerably ignorant. So very common is the unconsidered judgment that it is very probable we need not leave the town of Sedalia to find hundreds who accept or reject the theory of Darwin with equal certainty and confidence, neither of whom pretends to know anything of embryology, structural differences and affinities of geologic history. So thorough is this popular delusion that we must have some settled opinion, that most any of our unprofessional neighbors, at the first request, will not hesitate long before expressing his opinion upon the fluidity of the earth's interior, the result of the eastern war, the nature of the sun's heat supply, or Snell's discovery of the relation of incidence to the trigonometrical properties of the line. The time is not far distant when it will be considered that he who makes assertions ought to be competent to investigate them. These evils—not harmless in their character—cannot be corrected until a radical change is effected in our course of instruction. The order of mental processes is based upon the perceptions; from these perceptions, manifold in variety, conceptions are formed; the consideration, comparison and discrimination of conceptions from the reasoning process, and from this is derived the final judgment or conclusion. If any of these processes have been incomplete or wanting, to that extent is the conclusion vitiated or worthless. From a mistaken view of the antecedents and character of knowledge, we have the popular delusion that by simply reading definitions and generalizations in science, we thereby become scientific men, in full possession of scientific minds, able to see the full scope and bearing of scientific research, endowed with full authority to draw its boundary lines and make all needful and necessary restrictions. But the result of simply reading science is far different from this. The convincing power of a conclusion drawn from the domain of science is felt and known by an experimental knowledge of the data upon which the generalization rests. It is he only, who has had this experience, that knows the intricate and obscure phenomena, the grand evidences and the mazy labyrinth leading up the luminous track track to knowledge. The real and potential value of knowledge obtained by the developing effects of experience clashing with the alternately hopeless and treasured theory of a loved ancestry, obtained by the tortuous and tentative ways of truth-loving zeal, can not be picked up by the purposing nut gatherer of knowledge. Simple memorization of facts or their relations is neither the acquisition of science nor scientific power. If science includes the classification of facts it equally includes the classification of experiences. When, then, a public speaker expresses his opinion quite confidently upon a conclusion in science, before even a limited amount of confidence can be given, the listener is compelled to ask,

not whether he is a Mahommedan, Greek, Christian, Paulist, Deist, Rationalist or soft money man, but whether he knows of what he is speaking or has simply read up on the subject.

I wish to point out an intellectual result of science teaching, which, in its general character is felt rather than professed. Under the attentive eye of the student the electric current slowly decomposes the water, but, be the quantity little or great, the volume of hydrogen obtained is always exactly twice as great as the volume of oxygen. Repeating the experiment, under all possible conditions, the result does not vary. He tries rain water, salt water, the water from springs and rivers, but with the same unvarying proportion of two to one. Reversing the process of analysis, he takes two gills of hydrogen and mixing it with one gill of oxygen, and applying the heat they condense to form water again. Again he uses the same quantity of hydrogen, but two gills of oxygen; heat is applied, the same quantity of water is formed, but his extra gill of oygen remains. What can prevent this student from the belief that the water is not only constant in its composition, but that the force which binds its elements together is constant and invariable. He next takes common salt and has found by exhaustive experiments that of every 58½ pounds, 23 pounds are a peculiar metal, so light that it not only floats upon water but vividly burns on it, and that the remaining 35½ pounds are a stifling, green and poisonous gas. By various decompositions and recompositions he finds that the proportions are invariably uniform. Thus he studies the various facts and phenomena of nature —the fall of bodies, the resistance of fluids, the correlations of heat and motion, the interdependence of the two kingdoms of life, and stands convinced —self convinced—of the principle of uniformity in the action of forces and the universality of law. This idea has taken no slight hold of him. It is not a hollow profession to be used when convenient, but it is a part of his mental life, entering into every consciousness. In no case has an atom of matter terminated its existence, and nowhere has nature appeared inconsistent or capricious, Forces may, at times, have eluded his search, but nature never impresses him as extravagant and monstrous. The conclusions of uniformity in the processes of nature become knowledge in its true and only sense, as it is founded in perceptions, generalized into conceptions, wrought into reason and solidified into an indubitable conclusion. From these studies, he consistently, necessarily infers the existence of uniformity in other departments of human thought, no matter how great the authority to the contrary. The scientific study of nature powerfully predisposes to the idea that order reigns throughout creation, unmistakably effecting a state of mind that sees in the unknown an exhibition of law instead of chance, stability instead of vacillation, order instead of entanglement, and sincerity instead of duplicity. Science teaching requires the student to observe, analyze and compare; to combine and separate experiences; to search for the source of feelings; to question the views which he once held or now holds; to enlarge the requisites for proof; to suspend judgment; to

revise with impartiality. It is such discipline that develops the healthful and manly condition of mind that sees folly and stupidity in that narrow dogmatism which represents doubt as essentially sinful.

It is not probable that mankind will soon agree about the phenomena that surround and embrace life. The pick of rational investigation has too recently commenced its descent into the rich placers of the great unknown. Although the spirit of intolerance has not entirely made its exit, the habit of constantly appealing to the sources of knowledge, which requires us to lay aside old prejudices and yield to candid investigation, will effectually effect a good work, the importance of which we cannot now realize. The habitual examination of nature with instruments "appropriate to its study" cannot fail to produce a marked advance. I say "appropriate to its study" for all possibilities, probabilities and facts, must be derived directly from the objects to which they relate. The Archbishop of Salzburg was certain of the impossibility of the globular form of the earth, as, otherwise, a world of human beings would be beyond the reach of salvation. Theological arguments are instruments of power, but their leverage must be confined to the work for which they are fitted. In the minds of some the impossibility of the globular form of the earth was settled by the certainty that those people upon the other side cannot see Gabriel when he shall come to us.

We have not far to look back to find such phenomena as lightning, eclipses, the rainbow, explained by inferring the agency of evil spirits and theological conditions; and still more recently do we see the volcanic eruptions of Vesuvius brought (?) to a condition of repose before the august statue of St. Jannorius carried through the streets of Naples, followed by an insensate procession of its citizens, and to-day, on the crowded coasts of Sicily, we witness reverence upon bended knee, with lowered heads and folded arms, at the approach and passage of the public teacher along the streets. So profound has been the belief that evil spirits tamper with matter, setting aside its laws and intriguing with men and old women that we need feel no surprise at the persecution of the ancient philosopher, because he stated that the sun may be as large as all Greece (Airy). When, too, we recall the all but unanimous belief that the study of matter materializes our conceptions, and induces skepticism, hereticism, and sinful doubt, we are better able to repress the feelings rising within us, while contemplating Servetus "roasting for two hours at the stake prepared by Calvin, begging "for the love of God that they would put on more wood, or end his torture." Science Teaching solves the problem of toleration, for our ability to exercise it depends not upon loved and honest professions, but upon exactly the same laws as the faculties of generalization and reason. We may read the conditions of perception and the laws of reason, but to perceive with accuracy, and to reason with ability, requires a discipline, a use of these faculties upon the objects which exercise them. Likewise, we may see the propriety and justice of toleration, but the ability to tolerate when toleration is most needed, follows only an exercise of the moral sense upon objects that call it into real use.

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# SCIENTIFIC MISCELLANY.

## "CLEOPATRA'S NEEDLE."*

The obelisk known as "Cleopatra's Needle" is of great historical interest, because it had sculptured upon it the history of a man who quarried it from the old quarries of Syene (the modern Assouan), and the reason why he quarried it. There were few monuments extant, so far as we know, which could, like this, date back 3,400 year. In addition to its historical interest, however, the obelisk in question was of interest to engineers, in consideration of the means which were resorted to in order to quarry and transport in safety such a huge monolith. Cleopatra's Needle was not alone among obelisks, and possessed no peculiar features. In point of size, it stood only about eighth or ninth on the list of obelisks with which we were acquainted. The largest of which we knew was the Lateran Obelisk in Rome, which was brought by the Romans, with about twenty smaller ones, from Egypt, as the most curious objects they could lay hold of to decorate their imperial city. The Lateran Obelisk had a height of something like ninety feet, and was ten feet six inches square at the base, whereas Cleopatra's Needle was only sixty-nine feet three inches high, with a base of seven feet square. Ten years ago, when the lecturer was in Egypt, his attention was especially directed to this obelisk, which he saw lying in the sand on the shore at Alexandria. He dug around it and under it for the purpose of examining it, and it appeared to be little the worse for wear except that two of its sides were somewhat weatherworn, and did not retain the polish which still existed on the other two sides. Nevertheless, the hieroglyphic inscriptions were quite distinct enough to be read by the learned in these matters, and it therefore retained its history as clearly as on the day when it was set up by Thothmes III., *circa* 1400 B. C. Egypt in those days was the leading country of the world, not only in arts and commerce, but in learning and science, and to her great university of Heliopolis came Strabo, Pliny, Herodotus, and others. Thothmes went to the old quarries of Syene for the material of his obelisks. From these quarries for generations before him the Egyptians had been accustomed to sculpture those great blocks of granite which even to this day were our wonder and admiration. The granite of Syene was micaceous and somewhat coarse in texture and pinkish in color, and in the quarries, to the present day, there existed an obelisk, half cut out, much larger than any other we knew of. That obelisk, if it had ever been completely quarried and set up, would have been ninety-six feet high and about eleven feet square at the base. The proportion of height of these obelisks to the square of base was gen-

*A paper read before the Civil and Mechanical Engineers' Society.

erally about ten to one, or, in other words, the height was about ten times the square of the base. The hieroglyphics on "Cleopatra's Needle" were from two feet to three feet long, cut two inches deep and three inches or four inches broad, so that they could be read from a distance of fifty or sixty yards. The inscription, besides recording the virtues and power of Thothmes, recorded that the obelisk when set up was tipped with gold. This feafeature was of course gone, but there was a slight ledge round the point at the top which was no doubt made to receive a gold tip, or one of bronze gilt. On the top of the obelisk of Luxor at Paris, which the French brought from Egypt, there was a similar ledge or groove. The inscription on Cleopatra's Needle did not say in what city that obelisk was set up. Some accounts had it that it was first erected at Thebes, and was afterwards removed by Rameses to Memphis. Be that as it might, it was ultimately removed to the ancient city of Heliopolis. The site of that city, once the Oxford and Cambridge of the world, and at that time, it may be presumed, covered with magnificent buildings, now presented one of the most astounding spectacles which could be witnessed. Nothing remained but a green plain, in the center of which was a solitary obelisk, opposite to which once stood the stone now known as "Cleopatra's Needle." The latter was subsequently removed to Alexandria. How it came to be thrown down in its present position nobody knew. It had been conjunctured that an earthquake was the cause of its overthrow, but it was much more likely, Mr. Dixon thought, that it was thrown down to get at the bronze tortoise on which it was believed all these obelisks were placed. In 1798 the French conquered Egypt, and they laid their hands on everything that was valuable or invaluable in the country. They carried off an enormous quantity of Egyptian remains, and they proposed to carry off the Rosetta stone (now in the British Museum), Cleopatra's Needle, and other antiquities. Before they could do so, however, they were driven out of Egypt by the English, and at the conclusion of that brilliant campaign, in which Sir Ralph Abercrombie fell, a great effort was made to secure Cleopatra's Needle, which would when erected in London, form a fitting monument of one of the most brilliant campaigns in which English arms had ever been engaged. The army subscribed four or five days pay, and assisted by the navy, took steps to remove the obelisk. They had hardly commenced, however, ere the red-tape and pipeclay of those days sent forth an order to desist in the attempt, as such work would be destructive of discipline and of the accoutrements of the men. So the obelisk remained where it was. When Mehemet Ali assumed the reins of power, he, wishing to please George III, presented the Rosetta stone and many of the principal objects in the Egyptian Court of the British Museum, together with Cleopatra's Needle, to the English nation. The British Government, however, had always declined meddling with this obelisk, although repeatedly urged to bring it over. The expense involved was made the great obstacle, although even so utilitarian a man as Joseph Hume proposed to spend the national money in bringing over the

obelisk, and contended that the money would be well spent for such an object. The cost of bringing over the obelisk has been estimated in years gone by at £100,000, but Mr. Dixon said he was confident that the cost would not exceed one-eighth or one-tenth of that sum. Eventually the British Government had renounced the gift. Recently, as was well known, Dr. Erasmus Wilson, F. R. S., had magnificently come forward and had offered to find the money if Mr. Dixon would undertake the engineering details involved in the transport of the obelisk to England. That offer had been accepted. The Kedhive, on being spoken to on the subject by Mr. Fowler, his Highness's chief engineer, and who was now in Egypt, said he should be pleased to see the obelisk removed to England if the Government would accept it on behalf of the nation. This the government has consented to do, and it has again been presented to England through our Consul-General in Egypt. Nothing now remains, therefore, but to remove the obelisk to England.—JOHN DIXON, C. E., *in Van Nostrand's Engineering Magazine.*

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## DESICCATED EGGS.

It is already well understood that if albumen or white of egg be slowly dried in mass, or be dried rapidly at too high a temperature, a product or material will be the result which is of inferior and not uniform character or quality. Also, that if the yelk of eggs be dried in mass, slowly or rapidly, the result will be a material or product inferior in quality, not uniform in structure, difficult of solution, and of little value for the ordinary uses of the yelk of eggs. If batter of eggs composed of the whites and yelks together be dried in mass, the result lacks uniformity and solubility; and if either of these products, so obtained, be subsequently ground or pulverized, by any known process, the mealy result so obtained is of inferior quality, is slow of solution in water, and does not possess several of the important properties of the fresh shell eggs.

To meet this difficulty, the idea of the desiccation of eggs in rotation or agitation under the blasts of air, either heated or otherwise, has been variously applied during a long time past, both in this country and in Europe, but the difficulty mainly encountered has been that of producing a material capable of being preserved in different climates, of being readily and completely dissolved, and of being applied to the principal uses and purposes for which the egg may be applied before desiccation.

The natural egg contains, in varying proportions, a certain oil, hereinafter spoken of as the oil of the egg. This oil is a very important constituent of the egg. It is innocuous while in its natural condition—that is, in undisturbed combination with, or relation to, the other parts of the organism of the egg, its proportion thereto being relatively small.

When, however, this oil is set free by any process, it rapidly becomes rancid, highly offensive, and, in fact, acrid, and is a most potent and active

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agent in affecting the deterioration and decomposition of the other parts of the egg with which it may be brought in contact.

If, during the process of desiccation, the material to be desiccated is allowed to rise in temperature above a certain point, hereinafter indicated, the oil of the egg contained in the more solid parts, or which is not in suspension or emulsion, but is in more perfect combination with the other constituents of the egg, particularly that in the yelk, and so in the batter composed in the yelks and whites, is set free to a greater or less extent, according to the freshness and vitality of the eggs used and the degree of such heat. It has also been ascertained, by experiment, that the temperature at which this result follows varies at different times. The causes apparently depend upon barometric and other conditions of the atmosphere as well as the state of the thermometer. Such a result has usually followed whenever the material has been raised above 85° Fah. The highest temperature to which Mr. W. O. Stoddard, of New York city, who has made a special study of this subject, has been able to subject the material without that result following was 92° Fah.; but that was under exceptional atmospheric conditions, and he considers a much lower temperature than 85°, and, if possible, than 80°, very desirable for safety, and essential to commercial success in the manufacture. Indeed, his own operations have been conducted at a temperature not to exceed 80°.

Mr. Stoddard has lately patented (May 8, 1877) a device, the object of which is to regulate and control the temperature of the eggs, or parts of eggs, or batter of eggs, or other material during the process of desiccation, so as to prevent the development or freeing from the more solid part of such material of the oil of the egg not held in suspension or emulsion, being much the larger part of all the oil contained in the egg, and afterward to eliminate from the product derived such small portions of the oil of the egg as may have been held in suspension or emulsion, or may have been set free in the process of manufacture. The granulated or mealy product which is thus obtained will then, he claims, retain and protect its proper proportion of the oil of the egg, even if exposed to a much higher temperature than that above mentioned.

To obtain the object thus substantially set forth while employing for the process of desiccation a drying blast of warm air, he employs for the rotating surface, on which such desiccation is produced, a hollow cylinder, cone, frustrum of a cone, or other surface which may be artificially cooled by means of ventilation or evaporation in the interior while the material within is actively agitated.—*Scientific American.*

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## LIGHT-EMITTING FLOWERS.

The power of emitting light has been found to be possessed by several flowers. The daughter of the great Swedish naturalist, Linnæus, was wont

to amuse herself in the summer twilight by setting fire to the inflammable atmosphere which surrounds the essential-oil glands of the *Fraxinella*. One sultry summer evening, when sitting in the garden, she was very much surprised to notice the flowers of a group of nasturtiums emitting luminous radiants, and she observed the same thing occur on several subsequent evenings in June and July, 1762. The same phenomena has also been observed by several naturalists, but almost exclusively in connection with yellow or orange-colored flowers, such as the sun flower, the marigold, poppies and the orange lily. The following account of interesting observations of some of these luminous flowers is given by Dr. Phipson: "The Swedish naturalist Prof. Haggern, perceived one evening a faint flash of light dart repeatedly from a marigold. Surprised at such an uncommon appearance, he resolved to examine it with attention, and, to be assured that it was no deception, he placed a man near him, with orders to make a signal when he observed the light. They both saw it constantly at the same moment, The light was most brilliant upon marigolds of an orange or flame color, but scarcely visible upon pale ones. The flash was frequently seen on the same flower two or three times in quick succession, but more commonly at intervals of several minutes. When several flowers, in the same place, emitted this light together, it could be seen at a considerable distance. This phenomenon was remarked in July and August at sunset, and for half an hour when the sky was clear; but after a rainy day, or when the air was loaded with vapors, nothing of it was to be seen. On the 18th of June, 1857, about 10 o'clock in the evening, M. Fries, the well-known Swedish botanist, while walking along in the Botanic Garden at Upsal, remarked a group of poppies (*Papaver orientale*), in which three or four flowers emitted little flashes of light. Forewarned as he was by a knowledge that such things had been observed by others, he could not help believing that he was suffering from an optical illusion. However, the flashes continued showing themselves, from time to time, during three-quarters of an hour. M. Fries was thus forced to believe that what he saw was real. The next day observing the same phenomenon to occur at about the same hour, he conducted to the place a person entirely ignorant that such a manifestation of light had ever been witnessed in the vegetable world, and, without relating anything concerning it, he brought his companion before the group of poppies. The latter observer was soon in raptures of astonishment and admiratiotion. Many other persons were then led to the spot, some of whom immediately remarked that the 'flowers were throwing out flames.' It is chiefly in the summer months that the emission of light from flowers is seen, and generally during twilight. It is said, however, that flashes have also been noticed in the morning, just before sunrise. The light emitted is always most brilliant before a thunder-storm." —*Leisure Hours.*

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A MINE OF LIQUID SULPHUR.—In the vicinity of San Martino, near Palermo, Sicily, a mine of liquid sulphur is being worked; or, in other words,

large collections of the substance are being made at points where it flows from fissures in the rocks, in quantities of from four hundred to five hundred weight per day. The sulphur comes from a burning mine within the mountain; and, in order to give it time to cool, so as to admit of gathering it, the outlets are frequently closed for brief periods. Quite recently on opening one of these closed fissures, it was found that the sulphur had disappeared; and, in order to renew the flow, it was suggested to tunnel down toward the mine. Hardly was the work begun, however, before the pressure in the rear of the obstructing mass became too great for the latter to withstand, and a terrific explosion ensued, hurling the workmen into the air, killing five and wounding badly six more.

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DIAMOND HUNTING IN GEORGIA—Col. Lowman and Dr. Stephenson are washing for diamonds and rubies near the city, and have no doubt of success. Col. Lowman is practically acquainted with the workings of the Brazilian mines, and Dr. Stephenson is known to most of our people as an experienced miner and mineralogist. They are opening several veins of asbestos, and soon expect to open a corundum fissure, as the gold washings below the hill yield several pounds weekly of superior corundum, which justifies the belief that they will find the ruby and sapphire, all of which are chemically the same pure alumina. The specimens we saw are splendid. They also are finding elegant garnets and kyanites.—*Gainesville (Ga.) News.*

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A remarkable example of rapidity in deep boring has lately been furnished by the first bore hole put down by a company formed to search for coal in Switzerland. A depth of 1,422 feet was reached in two months, including the reboring of the upper 640 feet from 3½ inches to 7 inches in diameter. The work was done, including all delays, at the rate of over 1,000 feet per month, the highest speed being nearly 77 feet in 24 hours. The results obtained were negative, the section showing about 1,200 feet of Permian strata resting upon old crystalline rocks; but the trial is only the first of a series.

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A substitute for gunpowder, invented in England, is called "powder paper." It is paper impregnated with a mixture of potassic chlorate, nitrate, prussiate and chromate, powdered wood charcoal, and a little starch. It leaves no greasy residue on the gun, produces less smoke and less recoil, and is less impaired by humidity, and it is 5-16ths stronger than gunpowder.

# EDITORIAL NOTES.

## THE KANSAS CITY ACADEMY OF SCIENCE.

The society met at their rooms, 718 Main street, June 26th, President R. T. Van Horn in the chair. Minutes of last meeting read and approved. Rev. James G. Roberts, treasurer, made the following report:

| | Dr. |
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| To balance May 21, 1876 | $71 50 |
| To fees and dues May 31, 1876, to May 31, 1877 | 26 00 |
| | $97 50 |
| 1876, | Cr. |
| October 15, by cash book | $ 1 00 |
| October 30, by specimen case | 5 30 |
| 1877. | |
| Feb. 2, by postage, expressage, etc | 6 00 |
| By exploration of mounds | 10 00 |
| June 26, by cash on hand | 74 60 |
| | $97 50 |

Judge West moved that a committee of three be appointed to raise money for library and cabinet purposes. Committee—Messrs. West, Parker and Winner.

On motion, Prof. Parker was instructed to ascertain if the Kansas Academy of Science would hold the next semi-annual meeting of their society in Kansas City.

Dr. T. J. Eaton was appointed to read a paper at the September meeting.

Dr. Halley then read a carefully prepared paper on "Heat as a Remedial Agent," which appears in this number of tne *Review*.

Col. Van Horn thought that the Academy ought to continue their explorations of the mounds, and make their investigations as complete as possible.

On account of the the absence of many teachers and members of the society from the city during the heated term, the academy resolved to adjourn until the last Tuesday in September.

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On July 18th there arrived at the Union Depot one of the most distinguished scientific exploring parties that has ever passed West It consisted of Prof. Hayden, chief of the United States geological survey; Col. James Stevenson, of Washington; Prof. Joseph Leidy, of the University of Pennsylvania; Prof. Asa Gray, of Harvard University, and other distinguished scientists of the United States. They were accompanied by Dr. Joseph D. Hooker, President of the Royal Society of London, director ot the new botanical gardens, etc., and Lieut. Gen. Strachey, of the Royal Bengal Engineers, and a member of the council for India. These gentlemen some time since made arrangements, through friends in Washington and elsewhere, for a tour of scientific research this summer in Colorado, Utah and California, in company with the above distinguished Americans. The result of the tour will be communicated on the part of our countrymen, to the government at Washington, in the shape of reports.

Gen. Strachey has been for many years a prominent member of the Royal Geographical Society, and is now President of the geographical section of the British association for the advancement of science. He is author of several books of travel, and has a world-wide reputation as a geoprapher. Mrs. Hooker and Mrs. Stachey accompanied their husbands. The former was the widow of Sir William Jordan, an eminent naturalist, and Mrs. Stachey is the daughter of Sir J. R. Grant, formerly governor of Bengal, and at a later period governor of Jamaica.

At the depot the party was met by Judge West and Dr. Fee, of the Kansas City Academy of Seience, who exhibited to them a number of relics found in the mounds of Clay county. They were highly pleased with them, and spoke in warm terms of the energy displayed by Kansas City in establishing a museum, and prosecuting local scientific researches. The party only remained about thirty minutes, and then proceeded west to Denver. The results of this extended scientific tour, which has been thus arranged, will, it is believed, be of great interest and value, and these will be attained entirely at the private expense of the distinguished gentlemen who compose the expedition. —*Kansas City Journal of Commerce.*

XUM

The local committee appointed to make arrangements for the twenty-sixth annual meeting of the American Association for the Advancement of Science, to be held at Nashville, Tennessee, August 19, has issued a circular, expressing the determination to spare no efforts to make this the largest and most interesting assemblage in the history of the Association. They expect to be able to furnish private entertainment to every member of the Association willing to accept it, to secure for those who prefer it hotel accommodations at reduced rates, and to arrange with the railroads for the issue of free return tickets, as also to provide for such excursions in the vicinity as will render the meeting both pleasant and profitable. The secretary of the local committee is Professor J. Berrien Lindsley, and Professor N. T. Lupton is chairman of the committee on receptions, either of whom may be addressed at Nashville, for particulars.

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The invitation of Captain Howgate to the merchants of the large cities of the United States to assist pecuniarily in his polar expedition has been responded to very liberally. The contributions have been so generous that he has been able to procure the vessel necessary (the Florence) and she will sail on the 20th of this month from New London, where she is now being fitted out for her voyage. The officer to command her is Captain Tyson, of the merchant marine. He was navigator of the Polaris, and been on several polar expeditions. The Florence is manned mainly by Connecticut sailors. She may stop at Frobisher's straits upon her course, but her headquarters will be on Cumberland, where a stock of supplies will be collected, and a score of Esquimaux with dogs and sledges will be enlisted for the expedition. If Congress grants an appropriation for the Howgate colony, another vessel will sail from New York about July 4, 1878, and join Captain Tyson at Disco about August 5. Then they will strike north. Captain Tyson recently stated that he expected to stay in the frigid regions until he found the North Pole.

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Besides the complimentary notices which the *Review* has received from prominent Eastern papers, such as Popular Science Monthly, the American Naturalist, Harper's Weekly and New Remedies, we are highly gratified with the flattering reception it has received from the press of Missouri and Kansas: The Leavenworth Times, Kansas Farmer, Osage City Free Press, Chetopa Advance, Miami Republican, Kansas City Journal of Commerce, Kansas City Times, Post and Tribune, Price Current, Church Guide, Richmond Conservator, the St. Joseph Herald, the Western Dispatch, Caldwell Sentinel, The Jewel, Fireside Guard, Brookfield Gazette and Columbia Statesman have all greeted it warmly, besides several others of which we have heard.

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## BOOK NOTICES.

THE ANNUAL RECORD OF SCIENCE AND INDUSTRY, 1876, 839 pp., octavo, Edited by Prof. Spencer F. Baird, and published by Harper Brothers, N. Y. For sale by MATT FOSTER & Co., $2.00,

As we stated in the June number of the *Review* this is the best of the whole series which Prof. Baird has been editing for the past six years. The general summary of the progress of science and industry during the year 1876, occupies two hundred and thirty pages, and each general subject has been written up by an eminent specialist. Such an array of learned and talented writers is rarely brought together in one book, and their connection with it, alone, assures exhaustive research and the utmost accuracy of statement.

The remainder of the book, 609 pages, is principally devoted to abstracts of important and valuable papers on special topics, and to brief digests of the more important and useful points in each. Every branch of science is fully treated, and more information can be gained from this Record concerning the current history of these branches than from any other single volume in existence. Nothing equal to it is published in the world, and not only is it adapted to the astronomer, geologist and chemist, but to the farmer, the artisan and even the housekeeper. This is shown by the chapters on Agriculture, Domestic and Household Economy and Technology, comprising ninety pages, which contain information and instruction of the most definite and reliable character, based upon and deduced from the experiments and researches of distinguished

scholars in all countries in regard to such familiar topics as Manures, food for animals, noxious insects: Construction of buildings, lightning, heating and ventilation, clothing, the laundry and the table: Printing and engraving, moulding and casting, cleaning and bleaching, painting, staining and varnishing, plating, cementing and the utilizing of waste products. It is really worth more, directly, to the masses of the people than to scientists, because the latter are supposed to have more ready access to standard works and the special periodicals of their respective branches, while the latter are necessarily more dependent upon compilations and books of reference.

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A PRACTICAL TREATISE ON LIGHTNING PROTECTION, by Henry W. Spang, with illustrations, 180 pp., Ramsen & Haffelfinger, Philadelphia, Pa.

This is a practical treatise on electricity and its properties and phenomena, with plain common sense remarks upon lightning conductors, founded upon observation and well-known facts. The intention and object of the author are to show that lightning rods in common use are insufficient, and for the most part constructed on false principles, and to point out how many of the materials used in the construction of our buildings, such as water-pipes, metal roofs and rain pipes, may be utilized as safe and sufficient conductors. The chapters on protection of buildings, oil tanks, steam boilers, ships, wooden bridges, telegraph poles, are eminently practical, and may be read with advantage by all classes of people. The author is connected with telegraphing, and writes from an extensive acquaintance with the subject of electricity in all its economic bearings, and not in the interest of any "patent lightning-rod."

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THE ELEMENTS OF AGRICULTURAL GEOLOGY, by Wm. K. Kedzie, M. S., of the Kansas State Agricultural College. Wilson, Hinkle & Co., Cincinnati and New York. 96 pp.

This little work, prepared for the use of the schools of Kansas, reflects great credit upon its well known author, not so much for its profundity as for the skill which he has displayed in making it just what it is intended for—a manual for use in the schools. The trouble with most school books on the higher branches of learning is that they are too erudite, and that the learner fails to draw useful and practical inferences from them. He studies the text books, but at the close of his course, has no idea whatever of applying what he has learned to the ordinary pursuits of life. This will not be the case with those who use Prof. Kedzie's book. Every page has its practical teachings, and the youth of Kansas are to be congratulated upon having so valuable a text-book upon so important a subject.

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HOURS WITH MEN AND BOOKS, by William Matthews, LL. D. Chicago: S. C. Griggs & Co., 1877. 384 pp. $2.00.

Professor Matthews has reached the top round of the ladder as a brilliant and graceful essayist, and his works are read with all the interest ever felt in those of Hazlitt or De-Quincy himself. His versatility is equal to his brilliancy, and he writes *currente calamo* on all subjects. His treatise on "Words: their Use and Abuse," obtained a wide circulation, and received the commendations of the most careful critics in the country.

The present work has already passed to a third edition, which is at least an indication that the author's popularity is still on the increase. The mechanical work of the publishers is a model of excellence in paper, print and binding.

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POPULAR SCIENCE MONTHLY, AUGUST 1877, Appleton & Co., N. Y., pp. 128, $5.00 per annum.

With this number a change takes place in the editorial department by the association of Prof. W. J. Youmans with the former distinguished editor, Prof. E. L. Youmans, who has so ably managed this indispensable journal for the past five years. If doubling the editorial force shall have the effect to increase in the same proportion its usefulness and popularity, the American reading public will be fortunate indeed. The present number presents an unusually rich and varied table of contents.

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VAN NOSTRAND'S ECLECTIC ENGINEERING MAGAZINE, July 1877, pp. 96, Van Nostrand & Co, New York, $5.00 per annum.

We are much gratified to number this valuable journal among our exchanges, and can

safely promise those of our readers, who are interested in engineering and its kindred topics, frequent selections from its pages, which will amply repay them for the trouble of reading. This is a magazine which must be of the greatest interest to all engineers and mathematicians, being made up as it is from all the best scientific journals of the world devoted to these specialties.

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NEW REMEDIES, Monthly, pp. 32, Wm. Wood & Co., New York, $1.50

This is a monthly journal of materia medica, pharmacy and therapeutics, and is ably edited by Dr. Fred. A. Castle and Charles Rice.

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SIXTH ANNUAL REPORT OF THE KANSAS CITY PUBLIC SCHOOLS, 1876–77. 100 pp. Ramsey, Millett & Hudson, Kansas City, Mo.

The public schools of Kansas City are justly an object of pride to all good citizens, having kept pace with its progress in everything else, and being, unlike some of our public institutions, substantial and excellent, in fact as nearly perfect as good officers and teachers can make them.

We learn from the President's report that more than $8,000 of the floating debt has been paid off within the past year; that the financial condition of the district has steadily improved; that a handsome library has been established, and that the past year has been the most satisfactory and successful year, so far as the workings of the school system are concerned, since its introduction. A high and well-deserved compliment is paid Professor Greenwood and the teachers under his charge, and the report closes with thanks to the community for its unanimity in encouraging and supporting the Board of Education at all times.

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Among our most valued exchanges are the *Scientific American* and *Boston Journal of Chemistry*, both of which have at least a national reputation as the best publications of their class and to both of which we are indebted for some of our most interesting selections at different times.

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The rapidly succeeding numbers of Dr. Hayden's Bulletins of the Geological and Geographical Survey of the Territories, filled with important scientific material, already constitute a very extensive library of scientific monographs.

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PUBLICATIONS RECEIVED.

[*The receipt of all new publications delivered at the editorial rooms of this Journal will be acknowledged in its earliest subsequent issue. Publishers will confer a favor by promptly advising us of any omission in this respect. Accompanying memoranda of prices are desirable in all cases.*]

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| Annual Record of Science and Industry, Harper Bros., | $2 00 |
| Lightning Protection, Claxton, Ramsen, & Hafflefinger, | 1 50 |
| Agricultural Geology, Wilson, Hinkle & Co, | 1 00 |
| Hours with Men and Books, S. C. Griggs & Co., | 2 00 |
| Ethnography of Hidatsa Indians, Secretary of Interior, | |
| List of Elevations, Secretary of Interior, | |
| History of American Bison, Secretary of Interior, | |
| Bulletins 7 and 9, National Museum, Secretary of Interior, | |
| Popular Science Monthly, July and Aug., Appleton & Co, | 5 00 |
| Popular Science Monthly Supplement, July, Appleton & Co, | 3 00 |
| Eclectic Engineering Magazine, July Van Nostrand, | 5 00 |
| Scientific American, July and August, Munn & Co., | 3 20 |
| New Remedies, July, Wm. Wood & Co, | 1 50 |
| Boston Journal of Chemistry, July, Billings & Clapp, | 1 00 |
| Mines, Metals, Arts and R. R Journal, July, C. E. Ware & Co., | 2 00 |
| London Journal Applied Science, P. L. Simmons, | 4s. |
| Western Agriculturist, Quincy, Ills., July, | 1 10 |
| Sixth Annual Report of the Kansas City Public Schools, 1876–77. | |
| Telegraph Journal, London, Haughton & Co., | 4s. |
| Monthly Weather Review, June, Signal Office, Washington, | |
| Phrenological Journal and Science of Health, August, 1877, N. Y., | 3 00 |
| Druggists' Circular and Chemical Gazette, L. V. Newton, M. D., | 1 60 |
| Library Table, H. L. Hinton & Co, | 3 00 |
| Kansas Farmer, J. K. Hudson, | 2 00 |